

NEW AND BETTER WAYS

**FIELD
GUIDE**

FOR NOVA SCOTIA'S INNOVATION ECOSYSTEM



AN INNOVATIVE GROWTH
STRATEGY FOR NOVA SCOTIA

.....
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Innovation

“New and Better Ways of Doing Valued Things”

CONTENTS

List of Acronyms

<i>Foreword</i>	1
Introduction Why Nova Scotia Needs an Innovation Strategy.....	4
Chapter 1 Preparing the Talent for an Innovative Economy	23
Chapter 2 Building up Nova Scotia’s Research Excellence	34
Chapter 3 Nourishing the Startup Ecosystem.....	52
Chapter 4 Growing Innovative Exporters.....	76
Chapter 5 Developing a World-class Oceans Cluster.....	98
Chapter 6 Keeping Government Focused on Innovation.....	110
Executive Summary of Recommendations.....	120
Source References.....	132

Appendices

I Research, Development, and Commercialization Committee.....	135
II Project Meetings.....	136
III Biographies.....	139
IV Atlantic Growth Strategy.....	141
V Sales Training Syllabus.....	148

LIST OF ACRONYMS

ACOA	Atlantic Canada Opportunities Agency
AIF	Atlantic Innovation Fund
BCIP	Build in Canada Innovation Program
BDC	Business Development Bank of Canada
BDP	Business Development Program (ACOA)
BERD	Business Expenditure on R&D
BIC	Business Innovation Council (Acadia)
BL-NCE	Business-led Networks of Centres of Excellence
CAIP	Canada Accelerator and Incubator Program
CAUBO	Canadian Association of University Business Officers
CBU	Cape Breton University
CECR	Centres of Excellence for Commercialization and Research
CEED	Centre for Entrepreneurship, Education, and Development
CERC	Canada Excellence Research Chair
CFI	Canada Foundation for Innovation
CFREF	Canada First Research Excellence Fund
COVE	Centre for Ocean Ventures and Entrepreneurship
CRIAQ	Consortium for Research and Innovation in Aerospace in Québec
DFO	Department of Fisheries and Oceans
DRDC	Defence Research and Development Canada
DTAPP	Digital Technology Adoption Pilot Program
FDI	Foreign direct investment
GERD	Gross Expenditure on R&D
GHG	Greenhouse gas
HERD	Higher Education Expenditure on R&D
HQP	Highly qualified persons
HRM	Halifax Regional Municipality
ICT	Information and communication technology
IORE	Institute for Ocean Research and Enterprise
IPAC	Institute of Public Administration of Canada
IRAP	Industrial Research Assistance Program (NRC)
LAE	Labour and Advanced Education (Department of)
MEOPAR	Marine Environmental Observations, Prediction, and Response (NCE)
NCE	Networks of Centres of Excellence
NRC	National Research Council
NSBI	Nova Scotia Business Inc.
NSCAD	Nova Scotia College of Art and Design (University)
NSERC	Natural Sciences and Engineering Research Council
NSF	National Science Foundation (U.S.)
NSHRF	Nova Scotia Health Research Foundation
NSRIT	Nova Scotia Research and Innovation Trust
OECD	Organization for Economic Cooperation and Development

OERA	Offshore Energy Research Association
OTN	Ocean Tracking Network
PISA	Program for International Student Assessment
PSE	Post-secondary education
SBIR	Small Business Innovation Research (U.S. program)
SME	Small or medium-sized enterprise
SR&ED	Scientific Research and Experimental Development
SSHRC	Social Sciences and Humanities Research Council
STEM	Science, Technology, Engineering, and Mathematics
UIT	Uhma Institute of Technology
VC	Venture capital
VCAP	Venture Capital Action Plan
WIL	Work-integrated learning

FOREWORD

In February 2014, the ONE Nova Scotia Commission on Building Our New Economy, chaired by Dr. Ray Ivany, released what has become well-known as the “Ivany Report”. Entitled *Now or Never*, it painted a stark image of Nova Scotia’s future, describing a province impacted by years of sub-par economic performance, an aging population, and limited investment by business in innovation and export competitiveness. The report proposed a number of 10-year goals which, if achieved, would produce an economic transformation of Nova Scotia.

In response, the Government of Nova Scotia formed the ONE Nova Scotia Coalition to develop an action plan to achieve the Ivany Commission’s goals. The 15 volunteer members of the Coalition came from across the province and included leaders from business, labour, municipalities, First

“The Commission’s core message is this: Nova Scotia is today in the early stages of what may be a prolonged period of accelerating population loss and economic decline. These negative prospects are not, however, inevitable or irreversible.”
—*Now or Never* (2014)

Nations, the voluntary sector, social enterprises, the health sector, and universities and colleges. Based on extensive research, consultation, and internal discussion, the Coalition prepared a Collaborative Action Plan, entitled *We Choose Now*. That report, which was released in November 2015, included a comprehensive set of relatively high-level recommendations to drive the transformation needed to achieve the Ivany goals.

Meanwhile, and also in response to the Ivany Report, Nova Scotia’s Department of Labour and Advanced Education formed an “Innovation Team” in partnership with universities and the Nova Scotia Community College. The Team has been working collaboratively to maximize the contribution of the province’s excellent post-secondary education system to the agenda set out by the Ivany Commission. It has created working groups to address five themes: research, development and commercialization; student recruitment and retention; technology-enabled learning; entrepreneurship; and experiential learning.

The Research, Development and Commercialization (RDC) Working Group comprises representatives from each of the province’s universities and NSCC, the provincial government and ACOA (Appendix I). The group is co-chaired by Dr. Richard Florizone, President of

Dalhousie University, and Dr. Ray Ivany, President of Acadia University. It has been focused on the design and implementation of measures to bring to bear much greater research, development, and commercialization to help achieve the goals of the Ivany Commission and the recommendations of the ONE Nova Scotia Coalition.

The RDC Working Group decided that a detailed and up-to-date analysis was needed as a basis for a set of specific recommendations to the Government of Nova Scotia, business, post-secondary institutions, and other stake-holders. To that end, Dr. Peter Nicholson, with the assistance of Mr. Jeff Larsen, was asked by the Working Group, the provincial Department of Labour and Advanced Education, and ACOA to prepare an independent report recommending measures to stimulate much greater research, development and commercialization and to encourage more collaboration between business and post-secondary institutions. It quickly became evident that R&D and commercialization should be considered in the broader context of the relationship of *innovation* to Nova Scotia's economic performance. So, as detailed in the chapters following, this report develops a comprehensive strategy to support the "innovation ecosystem" through which research, development, and commercialization interact with myriad other factors to drive inclusive and sustainable economic growth, and ultimately the prosperity of Nova Scotians.

The work that has led to this report began in late May, 2016 and has been supported by two very capable graduate students, Alexander Ripley and Erik Fraser. The analysis and recommendations that follow are based on:

- extensive knowledge and reading of the theoretical and empirical literature on innovation, buttressed with evidence gleaned from a large base of statistical information;
- the many past policy reports on the economy of Atlantic Canada, and of Nova Scotia in particular;

10-Year Goals Proposed by the Ivany Commission

1. **Inter-provincial Migration:** a net gain of 1,000 working age persons per year.
2. **International Immigration:** triple the average number of new international immigrants annually to 7,000.
3. **Retention of International Students:** retain 10 per cent of foreign students who complete studies in Nova Scotia annually.
4. **Business Start-ups:** increase the number of new business starts to 4,200 annually.
5. **Value of Exports:** increase value of international and inter-provincial to \$20 billion.
6. **Export Trade:** increase the number of Nova Scotia firms participating in export trade by 50%.
7. **Labour Force:** raise participation to Canadian rate or higher.
8. **First Nations and African Nova Scotian Employment Rates:** raise to parity with provincial average.
9. **Youth Unemployment:** lower rate to national average.
10. **Post-Secondary Education and Training:** increase population of adults who complete a post-secondary program from 55 to 65 per cent.
11. **Universities R&D:** double research funding to \$360M annually.
12. **R&D Partnerships:** double number of R&D partnerships between industry and post-secondary institutions to 2,000 per year.
13. **Venture Capital:** increase per capita investment to national average.
14. **Tourism Expansion:** increase revenues to \$4 billion
15. **Fisheries and Agriculture Exports:** double export value of both on a sustainable basis.
16. **Domestic Markets for Agricultural Products:** double the value of products produced and consumed in Nova Scotia.

- consideration of the implications of the Government of Canada’s developing innovation agenda and Atlantic Growth Strategy;
- meetings with senior officials of the federal and provincial governments; and
- extensive consultations with entrepreneurs, innovators, experts and decision-makers (Appendix II).

In addition, this work was informed by the extensive process and consultations undertaken by the ONE Nova Scotia Coalition, for which Peter Nicholson and Jeff Larsen provided secretariat support.

The wealth of experience conveyed in the course of these consultations has had a definitive impact on the findings and conclusions of this report and is gratefully acknowledged. The interpretation and recommendations reported here are nevertheless the sole responsibility of the lead authors, Peter Nicholson and Jeff Larsen.

The report begins with an introduction that explains why Nova Scotia needs an innovation strategy, followed by six chapters that describe the principal components of such a strategy: preparing talent; building up research excellence; nourishing the “startup ecosystem”; growing innovative exporters; developing Nova Scotia’s oceans cluster; and keeping government focused on innovation.

Each of the chapters includes recommendations directed either to the Province¹ or to the federal government in collaboration with the Province in the context of the Atlantic Growth Strategy. The full set of recommendations is collected in a final section that serves as an Executive Summary.

Building on the seminal analysis of the Ivany Commission in *Now or Never*, the fundamental thesis of this report is (i) that the future prosperity of Nova Scotia depends on creating a more productive and competitive economy, (ii) that this must be inclusive and sustainable growth that benefits all regions, and (iii) that this objective can only be accomplished by embracing and supporting innovation – *New and Better Ways*. The analysis and recommendations that follow constitute a comprehensive, integrated strategy to that end—a “Field Guide” to Nova Scotia’s innovation ecosystem. The recommendations are specific and actionable. They can drive results.

Peter Nicholson and Jeff Larsen

¹ Throughout this report, the word “Province” (capitalized) refers to the Government of Nova Scotia, whereas “province” indicates the geographic entity.

Introduction: WHY NOVA SCOTIA NEEDS AN INNOVATION STRATEGY

“Innovation is the central issue in economic prosperity” —Michael Porter

Nova Scotia is a wonderful place to live. We want to keep it that way—for ourselves, for our children, their children, and for generations to come. Lately there has been a lot to celebrate. Nova Scotia received more immigrants in the first six months of 2016 than in all of last year or in any of the previous 10 years. Our population has hit 950,000, the largest ever. The Conference Board estimates that Halifax will have the second strongest growth among Canadian cities this year. Exports have been up strongly, driven by exceptional growth in the world’s demand for quality Nova Scotia seafood. Tourism is having a record year. New technology-based startups have been springing up at an increasing pace—the acorns from which future economic oaks can grow. The multi-billion dollar naval ships contract, together with exceptionally large new investments in oceans research, have set the stage for a world-class oceans-technology economic cluster in Nova Scotia.

This is all very good news. It is giving rise to a new optimism and confidence that have been in too short supply for generations in Atlantic Canada. Now the momentum has to be sustained. Clearly, there is still work to do. Too many young Nova Scotians, including many of our most trained and talented, have reluctantly decided they have better prospects elsewhere. Our rural areas and small towns struggle to sustain an economic base and continue to depopulate. Our population, among the oldest of the provinces, strains tax-payer funded services while the workforce to support the tax base is certain to decline if things do not change. Although immigration is seen by some as the answer—and certainly it is important—the fact is that Nova Scotia has not been able to attract anything close to its proportional share of newcomers to Canada.

All of these longer term trends stem from a common cause—a chronically under-performing economy. The rate of growth of Nova Scotia’s gross domestic product (GDP) has been, on average, the slowest among the provinces over the past 25 years. Unless and until economic performance improves significantly on a sustained basis, the trends can only worsen for the simple reason that economic decline triggers a vicious circle that accelerates the decline. That was the key message brought home with exceptional force and clarity in the 2014 report of the “Ivany Commission”—*Now or Never*. There is no need here to repeat at length the portrait of Nova Scotia’s condition so well documented in that report, except to provide a reminder that the challenge is still before us.

So how do we continue to ride the wave of recent successes to reach the tipping point where success becomes self-generating—where more and more Nova Scotians conclude that “We can do it too.” The aim of the present work is to recommend a set of actions to help turn Nova

Scotia’s economy around for good; to propose a treatment to respond to the core of the Ivany Commission’s diagnosis. The essential ingredient of the treatment is “innovation”, understood as *new or better ways of doing valued things*. Of course, a lot of complexity is concealed within those simple words. So a further objective of this report is to explain how innovation can ultimately be the main driver of Nova Scotia’s future prosperity.

We know that innovation springs from the creativity of entrepreneurs; from researchers and highly trained individuals; from curious and motivated workers; from artists and designers; and from back-yard tinkerers. So is there really any role for government? Definitely there is. Public policies, programs and investments set conditions where innovation can either flourish or wither—for example; incorporating “computer literacy” and enhancing math skills in P-12 education; funding basic and applied research; early-stage finance to help innovative startups get started; financial incentives to overcome the natural reluctance to take risks; regulation that encourages rather than stifles initiative. All of these issues and more are addressed in the chapters that follow. The result is a coherent set of quite specific recommendations—*an innovation strategy*—designed to help create a more dynamic, competitive and prosperous Nova Scotia, one that is inclusive, sustainable, and benefits all regions of the province.

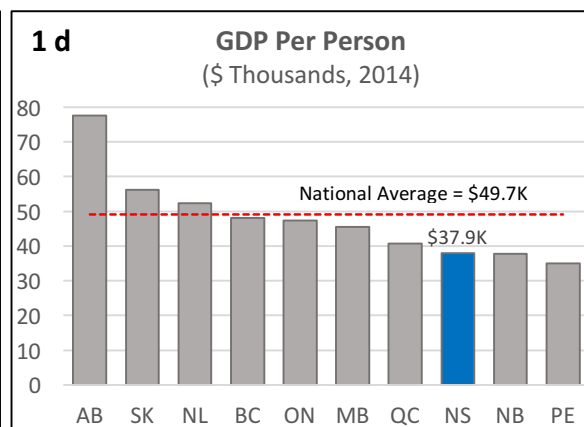
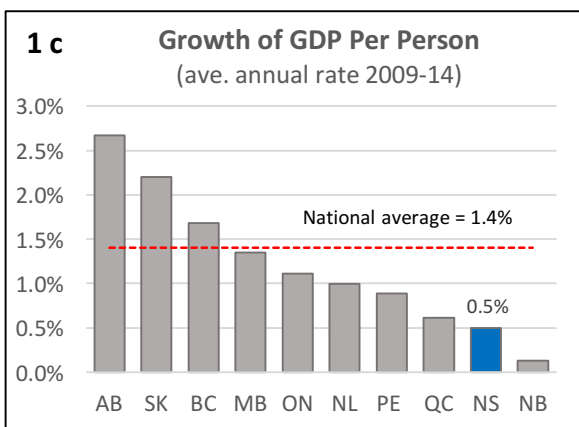
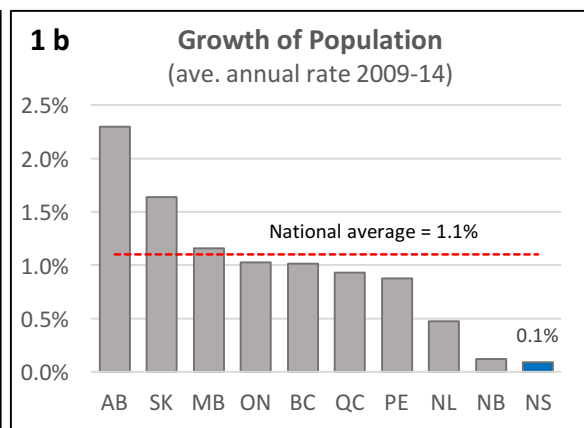
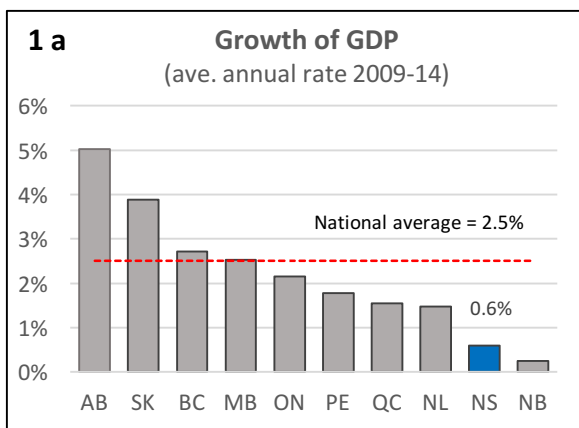
The purpose of this introductory chapter is to set the stage; first with a brief recap of Nova Scotia’s recent economic performance, focusing on the growth of gross domestic product (GDP) and its key underlying components of workforce demographics and productivity. Since the demographic outlook is far from favourable, prosperity will depend more than ever on stronger productivity growth. Here is where *innovation* enters the picture as the key driver of productivity. This fundamental connection is described in the context of one particular Nova Scotia example—the remarkable story of the Honeycrisp apple. Virtually every relevant linkage between research, innovation and economic success is illustrated by this case. The Honeycrisp is only one among many examples of Nova Scotian innovation but it shows what is possible even in the most traditional of sectors. The core economic challenge, and opportunity, facing Nova Scotia is to find ways to foster many more such examples: from high-tech startups to established businesses, large and small.

Nova Scotia’s economy from a national perspective and looking forward

The most comprehensive single measure of the state of an economy is its output of goods and services—Gross Domestic Product, or GDP. The GDP is the sum of the market values of everything produced as a result of measured economic activity inside the borders of a jurisdiction like Nova Scotia. While GDP does not measure the *quality* of life in any direct way—and is often criticized for not taking sufficient account, for example, of things like environmental impact—the fact is that GDP correlates closely with many indicators of quality of life including average health status; the extent and quality of social services; average level of education; average incomes, among many others. That is why we have come to accept that GDP per person,

despite imperfections, is still the best single indicator of the *average* standard of living. Of course the distribution of income matters hugely for the fairness of society, but that issue is ultimately constrained by the overall “size of the pie” to be distributed, and the pie is GDP. Figure 1 shows the recent trends of GDP and its per person average across the 10 provinces, focusing on the post-recession period: 2009-14 (the latest year for which a complete provincial breakdown is available from Statistics Canada.²)

- The average annual growth of Nova Scotia’s GDP was only 0.6%, next to the slowest among the provinces (New Brunswick trailed) and far below the Canadian average of 2.5%.
- The growth of GDP is equal to the growth of GDP per person plus the growth of the population. Nova Scotia’s population growth rate was almost zero, the lowest among the provinces between 2009 and 2014. And the growth of GDP per person (1c) was also very weak—next to last among the provinces.
- The bottom line (1d) is that Nova Scotia’s GDP per person in 2014 (\$37,900) ranked 8th among the provinces; was \$11,800 or nearly 24% below the national average; and was not trending favourably.



² The source references for all Figures will be found in the table of references at the end of the document.

The GDP per person is the key number for two reasons: (i) it reflects the average material living standard of Nova Scotians, and (ii) it represents, to a close approximation, the province's per capita **tax base**.³ Thus GDP per person is the source of funds for all the public services that Nova Scotians care about and that dominate the public's perception of the performance of government. So while the GDP per person is an abstract concept that no voter actually sees, it is in fact the basis of almost everything the voter actually cares about.

In order to connect the abstraction of GDP per person to its concrete implications for government, we have to dig a bit deeper. The GDP per person (i.e. GDP divided by the total population) is equal, by definition, to GDP per worker multiplied by the number of workers as a fraction of the population.

$$\text{GDP/Population} = (\text{GDP/Worker}) \textit{ times} (\text{Workers/Population})$$

The factor, GDP per Worker, is a definition of *productivity*.⁴ The second factor—the number of workers divided by the total population—is a demographic variable that depends on the relative size of the population that is of working age (usually taken as ages 16 through 64); the labour force participation rate; and the unemployment rate. So the essence of the simple relationship above is that GDP per person is the product of *Productivity* and *Demographics*. And the rate of growth of GDP per person is equal to the rate of growth of productivity plus the rate of growth of workers as a fraction of the population.⁵

On present course, this basic fact of *arithmetic* has ominous implications for Nova Scotia. That is because the province's aging population means that the potential workforce is shrinking as a fraction of the total population. And this means that productivity growth is the *only* way to keep GDP per person growing; or in other words, to keep the per capita tax base from shrinking and average living standards from falling.

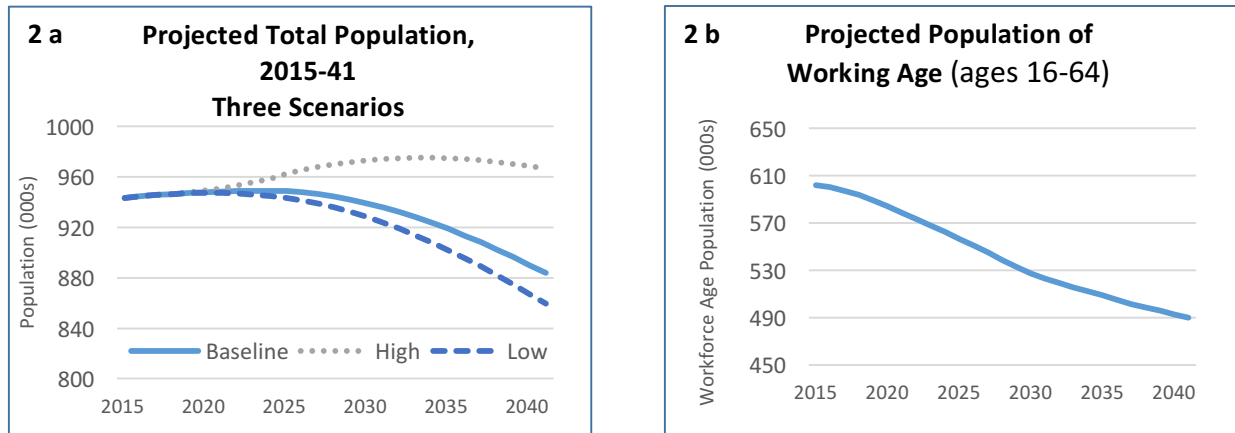
The scale of the challenge is seen in Fig. 2 (a) which depicts three scenarios—High, Low, and Baseline—for Nova Scotia's population out 35 years to 2041. Even in the "High" case, which assumes immigration rising to the national per capita average, the population peaks at under 980,000 in about 2034 and then declines slowly. Of greater economic significance is the

³ GDP is essentially equal to the sum of all incomes—personal and business—earned as a result of measured economic activity within the province. This is the base for income taxes and, as incomes are spent, also for sales taxes.

⁴ More precisely, GDP per worker is labour productivity and is more accurately defined as GDP per hour worked.

⁵ It is a simple mathematical derivation that the rate of growth of the *product* of two variables is the *sum* of the rate of growth of each.

projected decline of the working age population which, in the Baseline scenario, falls steadily from slightly more than 600,000 today to about 525,000 in 15 years' time; a decrease of more than 75,000 potential workers and tax-payers in a very short period (Fig. 2 (b)). This is a projection on present course. It is not necessarily destiny. But unless Nova Scotia's economic performance improves significantly, there is no reason to believe that the demographic trend will reverse itself—no reason why more young people will decide to stay or why more immigrants will be attracted and remain. On the contrary; without a more strongly growing economy, the working age population could fall even more sharply than projected, with the risk of triggering an *accelerated* spiral of decline.



Scenario Assumptions

Baseline scenario: Short-run net-positive migration as a result of weakness in the Alberta economy, returning to net-negative long-run. 10-year average of immigration is maintained, with added numbers for influx of Syrian refugees.

High Growth: Immigration rate increases to national average. Net interprovincial migration declines to a long-run average of net-zero

Low Growth: Immigration persists at 10-year average, with no increases except for allowance for Syrian refugees. Net interprovincial migration is constant in short-run, but declines to a lower long-run average.

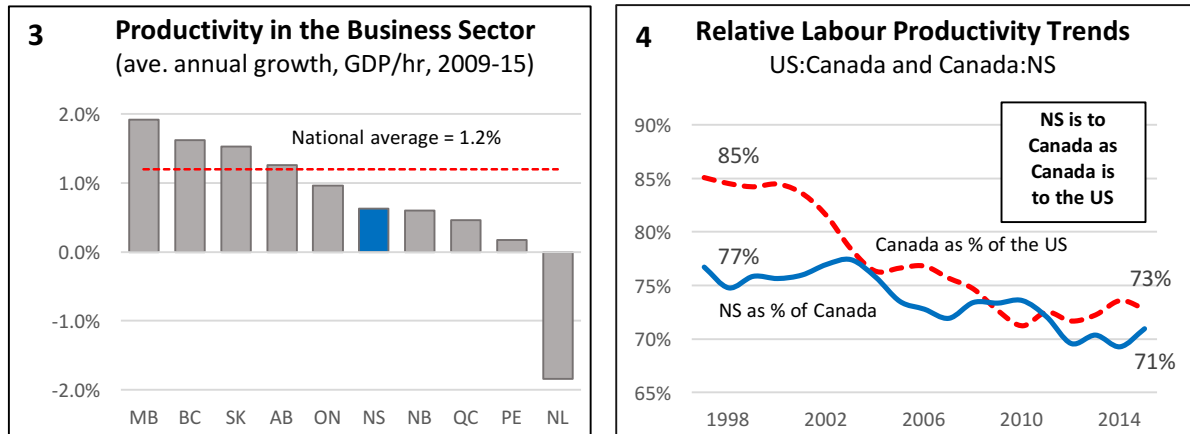
(Source: Nova Scotia Department of Finance)

The central importance of productivity growth and innovation

We come back, therefore, to productivity growth as the only way to turn Nova Scotia's economic prospects around. So where does the province stand today? Figure 3 shows that Nova Scotia's annual average business sector productivity growth over the 2009-15 period, at 0.6%, was well below the already weak national average of 1.2%, but comparable to that of Quebec and New Brunswick.⁶ (The all-Canada average is dominated by the four western provinces, and not just due to the energy sector.) On a longer trend, Nova Scotia's productivity has generally been declining as a percentage of the national average, while Canada's productivity level has itself

⁶ Newfoundland's productivity growth was on average strongly negative, reflecting the large up and down of the offshore oil sector. This is anomalous but sometimes occurs in very capital intensive economies dominated by a resource sector. The emphasis looking forward should be on the rate of productivity *growth*. Based on the *level* of productivity (GDP per hour worked in the business sector) Nova Scotia ranked 9th in 2015, just behind NB and ahead of PEI.

fallen significantly relative to that of the United States (Fig. 4). This particular pattern reflects a more general phenomenon, which is that Nova Scotia bears a relationship to Canada that roughly mirrors Canada’s relationship to the U.S. For example, business spending on research and development in Nova Scotia trails Canada to about the same degree that Canada trails the U.S. The implication is that Nova Scotia’s economy has been performing far below the global leaders and has not been catching up.



What drives productivity growth? While there are a great many contributing factors at the scale of an individual enterprise, at the aggregated level of the economy the following are most significant:

- An increase in the *quality of the workforce*—education, training, experience, creativity, motivation,...
- The growth of *investment* in appropriate technology; in intangibles like R&D, data, and organizational development; and in public infrastructure
- The *scale of activity* since, up to point, larger volumes can usually be produced more efficiently on a per unit basis. This underlines the importance of exports as the way to overcome the limitations of a small market like Nova Scotia’s; and
- *Innovation*—new or better ways of doing things—the collection of activities by which imagination and drive create entirely new types of value and/or more efficient ways of producing existing types of value.

Of these factors, innovation is the most fundamental because: (i) the skills that drive the quality of the workforce increase the economy’s innovation capacity; (ii) innovation is also embodied in *investment* goods and services, like new generations of technology that enable workers to produce more per hour, or in the R&D investment that leads to entirely new products; and (iii)

innovation drives business competitiveness and therefore enables the innovator to expand its market and capture *scale economies* that increase productivity.⁷

Recapitulating—Nova Scotia’s standard of living, and its ability to sustainably finance the quality of public services Nova Scotians expect, depend ultimately on GDP per person. But because of population aging, the growth of GDP per person will rely increasingly on stronger productivity growth. And the key to stronger productivity growth is a greater commitment to innovation by both business and the public sector.⁸

The Honeycrisp apple—a parable of Nova Scotia innovation

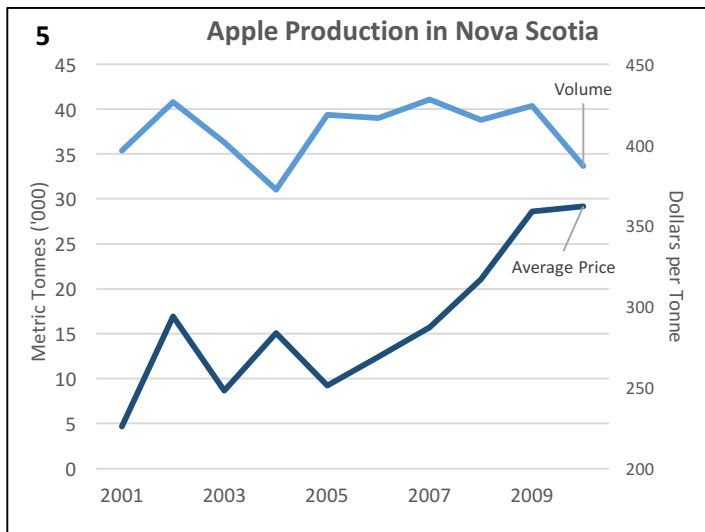
Twenty years ago, Nova Scotia’s apple industry was in steep decline. Rising production costs, combined with increasing international competition, brought the industry to a crossroads—either commit to turning the business around or exit the apple industry altogether. Unwilling to call it quits, Scotian Gold, a cooperative of nearly 30 apple growers, hired Larry Lutz, a tree fruit specialist, to travel with a group of other growers to South Africa and across North America in search of better technologies and high-value varieties that could thrive in Nova Scotia’s comparatively short growing season. In early 1996, during one of these trips (to Washington State), the group asked about a new species they had been hearing about. Their host at the time reached into his fridge and shared a taste of an apple that was to transform the industry in Nova Scotia—the Honeycrisp.

The apple had been rediscovered by David Bedford at the University of Minnesota, who saved the species from a test field of cross-breeds that were set to be destroyed. A lack of documentation in the testing facility meant that, to this day, nobody knows for sure which two species mixed to create the Honeycrisp, but Bedford recognized its potential as a crisp and sweet ‘hand apple’. Despite needing very particular growing conditions and high input costs, the industry took a liking to the Honeycrisp for its long shelf life and high selling price. The group of Scotian Gold growers in Washington bought all the Honeycrisp trees their host could offer (between three and four thousand). Three years later they had their first crop and demand for the Honeycrisp was high. Nova Scotian farmers quickly discovered that provincial growing conditions were optimal for the Honeycrisp as well as other high-value species like Gala and Ambrosia. The provincial government agreed and in 2005 created the 5-year, \$1.5 million Orchard Renewal Program to encourage farmers to replace existing varieties with more-

⁷ Productivity growth is often misunderstood as “working harder”—longer hours for little or no extra pay. Properly defined, productivity growth refers to generating more (market) value in any given unit of time, usually by working “smarter” with the help of better technology and better management methods and/or turning out a product that is more valued in the marketplace; all of which are the fruits of innovation. It is a separate but crucially important issue as to how the productive benefits of innovation are shared among owners, managers and other workers. The increasing concentration of income at the top over the past 40 years, especially in the U.S., signals a breakdown in the process of distribution, but is not an indictment of productivity growth itself.

⁸ Innovation in the public sector is addressed specifically in Chapter 6.

profitable ones. The program facilitated adoption of an innovation developed elsewhere in order to improve productivity in Nova Scotia.



As farmers began converting their orchards, Scotian Gold and the Nova Scotia Fruit Growers’ Association turned their attention to improving the quality and yield of the industry. Research collaborations with the federal Department of Agriculture (and a few with the Nova Scotia Agricultural College in Truro, now part of Dalhousie), with funding support from the Province, identified best-practices in growing and storing the Honeycrisp. More-recently, Scotian Gold and the

Fruit Growers’ Association have initiated collaborative research on the growth potential of other high-value varieties in Nova Scotia. Discovering new and sustainable apple varieties is part of the role of Sean Myles, the Canada Research Chair in Agricultural Genetic Diversity at the Dalhousie agricultural campus, and the research team at the (federal) Atlantic Food and Horticulture Research Centre in Kentville. The team developed the Apple Biodiversity Collection, a research orchard that contains more than a thousand different apple varieties.

Today, the Honeycrisp has become the most-popular variety (by volume) grown in Nova Scotia and makes up 18% of the province’s orchards. Scotian Gold continues to expand, recently constructing new storage and packaging facilities using revenue generated by the renewed apple industry and government-sponsored infrastructure support programs. Scotian Gold’s efforts, supported by the Orchard Renewal Program, have enabled Nova Scotia’s apple farmers to increase the productivity of their orchards, keeping up with an increasingly competitive global market. The renewal program has been so successful that the State of New York used it as a model when developing its own orchard growth strategy. The story of the Honeycrisp has also garnered the attention of the International Fruit Growers’ Association, which hosted its annual conference in Halifax in 2014 and has sponsored two delegations to visit Nova Scotian orchards.

Like any innovative initiative, the Honeycrisp boom in Nova Scotia will not last forever. Researchers at the University of Minnesota anticipate a decrease in the average quality, and increase in the quantity of the Honeycrisp supply, as farmers around the world begin growing the popular variety in non-ideal climates. This anticipation has led to the recently invented Sweetango apple, a cross-breed of the Honeycrisp and Zestar varieties. The bad news is that the apple industry is expecting the Sweetango to start cannibalizing Honeycrisp’s share of the hand

apple market over the next few years. But the good news is that the Province has already committed to invest \$2.2 million between 2014 and 2020 to leverage \$6.8 million from industry and replace 10% of the province's existing orchards with emerging and more-profitable varieties. Innovation is a race without a finish line!

The Honeycrisp story illustrates the most important aspects of innovation's contribution to economic growth:

- Too often it takes a crisis to stimulate innovation whereas it should be a priority for any well-managed business.
- Serendipity plays a big role in innovation because you never really know where success will come from.
- The economic payoff from innovation consists primarily of the *adoption/adaptation* locally of ideas and products (like the Honeycrisp) originally developed elsewhere.
- It is important, therefore, to get out of your own backyard because most of the great new things are to be found beyond the borders of Nova Scotia.
- Research and development efforts can support identification of the 'next big idea', but can also help identify how the 'next big idea' can be adopted here in Nova Scotia.
- Collaborative groups (like the Scotian Gold Co-op), supported with public funds, are often needed to mobilize and scale-up an innovation.
- Innovation is not limited to high-tech and startups, but can be found anywhere, including in the most traditional of industries, a lesson that Nova Scotia must take to heart.
- The success of the Honeycrisp has been followed by basic and applied research to enable the continuing innovation that is the only way to keep Nova Scotia apple farmers at the leading edge of an intensely competitive global industry.

The importance of fundamental research

“Without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world.”

—Vannevar Bush, *Science, the Endless Frontier*, 1945

The seminal report, *Science, the Endless Frontier*, by the U.S. Presidential Science Advisor triggered an era, following World War II, where fundamental, curiosity-driven research became a national priority for government and business in the U.S. Scientists and engineers enjoyed the respect of leaders and citizens, particularly given the role of science in winning the war—from radar to mass-produced penicillin to the atomic bomb—and its importance in winning the new “cold war” with communism. Today the context has evolved, but the principles put forward by Bush remain just as valid. We still need mission-oriented basic research and science in the war against disease, to create new products industries and jobs, and for security and welfare. Of course, as discussed later, fundamental research must be complemented with applied R&D, public investment, and the commercial development of products that appeal to customers, all of

which constitute a dynamic, interconnected innovation ecosystem.

In the post-war period, business investment in R&D in the U.S.—including through such giants of the time as AT&T, IBM and Xerox—grew to exceed government research spending in the 1970s. However, the shift included a growing trend by business to spend less on basic research and more on applied R&D in the service of the incremental innovation associated with continuous improvement and efficiency. This trend in business R&D has only intensified since, and has left the responsibility to sustain the advancement of fundamental knowledge largely to the academic sector. Investment in basic research is essential for innovation, and also leads ultimately to large spin-off benefits for the broader economy. But these fundamental advances cannot be captured by individual companies (unless they enjoy a monopoly in some domain) and so business lacks the incentive to invest in the most fundamental forms of research. Governments have therefore had to fill the gap through the essential support of fundamental research in universities while providing increased incentives to encourage research partnerships between businesses and universities.

For a small economy like Nova Scotia’s the imperative to support post-secondary research is not so much to create world-changing innovations, although those would certainly be welcome were they to occur, but more to generate the knowledge workers who “think for a living” as Peter Drucker said. The role of research as the key driver of the highly-qualified talent “assembly line” is discussed further in Chapter 2 in the context of research excellence.

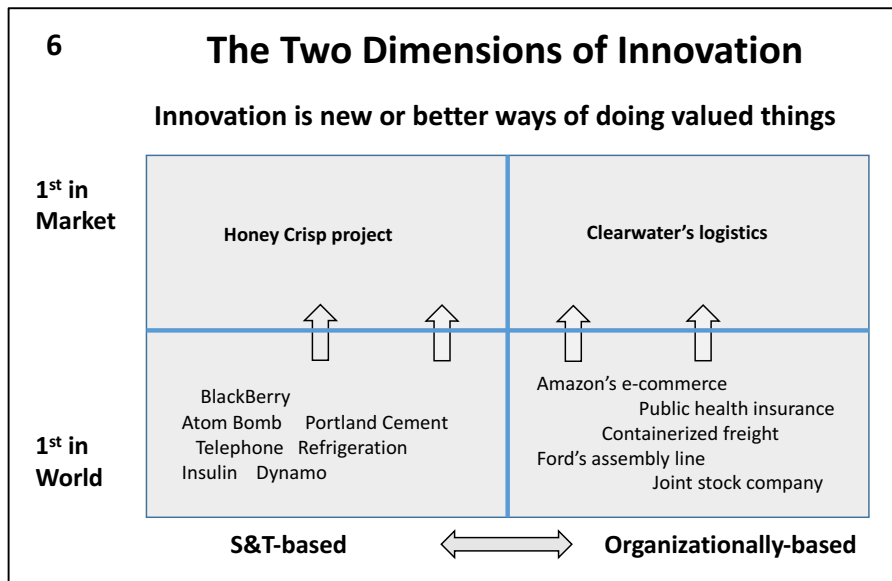
A broader conception of innovation

When we hear the word “innovation” it often conjures up an image of someone in a lab coat shouting “Eureka!” The Honeycrisp story is so instructive because it conveys a broader conception, and one that more accurately conveys innovation’s economic significance. In the first place, innovation occurs all along a continuum (Fig. 6) that does in fact begin at one end with things that originate in the most esoteric domains of science and technology (S&T)—the nuclear physics that led to both the bomb and the power reactor; the microbiology and genetics that underlie drug development; the materials science and engineering that enable millions of transistors to be etched on a tiny chip of silicon. These and countless others like them are innovations that changed the world and have returned the public’s investment in scientific research many thousands of times over.

At the other end of the horizontal continuum in Fig. 6 are what might be called organizationally-based innovations. They include transformative “process innovations” like the manufacturing assembly line, containerized freight, Amazon’s e-commerce business model, and Uber’s taxi service. Within the class of organizationally-based innovations are also those that are fundamentally “social”—innovations like the limited liability corporation, unionization, public health insurance, the condo dwelling model, and of course, social media. These social and

process innovations have been every bit as world-changing as those based on S&T. In fact, the interdependence between innovations that are S&T-based and those that are organizationally-based has greatly enhanced the value of each.

There is a second essential characteristic of innovation that is illustrated by the vertical dimension in Fig. 6. That is the distinction between an innovation that is “first-in-the-world” and one that is first in a particular market, or industry, or community. The world-firsts are obviously essential, and they get all the public attention, but they are of little economic or social significance until they *spread*. Indeed, an “invention” is not considered to be an innovation until it has achieved significant broad impact.



The importance of an innovation is therefore determined primarily by the extent of its *diffusion*—its adoption and adaptation by users, often very far from the location of origin. The Honeycrisp was not invented in Nova Scotia—in fact it was largely ignored where it was developed. But it was a major innovation

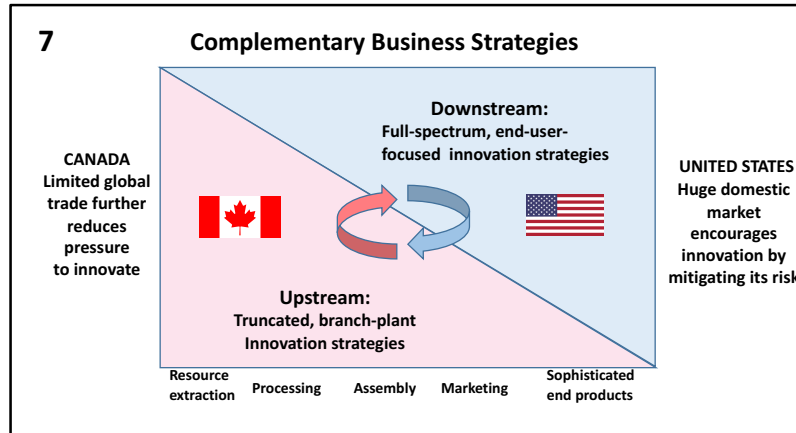
for Nova Scotia’s apple industry. This is the rule, not the exception. While it is a great thing when a significant world-first innovation is developed in Nova Scotia—a new rapidly-growing company would be the result. But such cases will always be relatively rare for the simple reason that Nova Scotia (and in fact, Canada) accounts for only a very small percentage of the world’s population of potential innovators. Most of the great ideas will be developed elsewhere. But then they can be discovered, brought home, and adapted in Nova Scotia, just as the Honeycrisp was. From this perspective, an innovative company or society is one that is *quicker and more effective* than most in discovering, adopting and then adapting the best ideas and equipment and practices wherever they may have originated. This is in fact how most innovation is ultimately employed to drive productivity growth and prosperity.

This means that a public policy strategy to stimulate innovation should include a prominent role for measures that facilitate the earlier awareness of, and adoption of the global stock of innovation—e.g., ensuring that the province’s post-secondary research institutions are enabled to equip students at the leading edge of knowledge; assisting international scouting trips (of the sort that led to the “discovery” of the Honeycrisp); expanding technology outreach and adoption

services like the federal Industrial Research Assistance Program (IRAP); fostering, through mentorship and other incentives, a more global, export-oriented outlook on the part of SMEs. Several specific recommendations in this regard are proposed in later chapters.

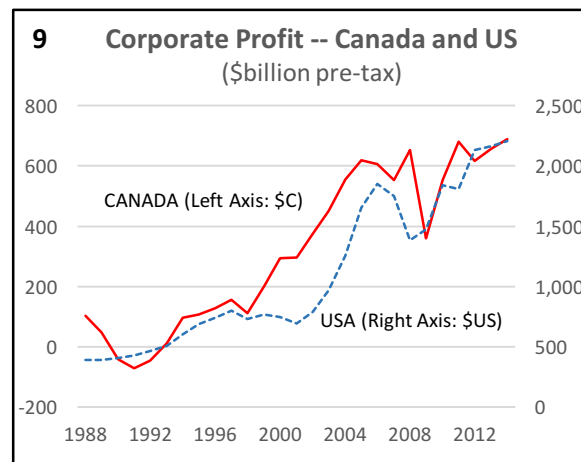
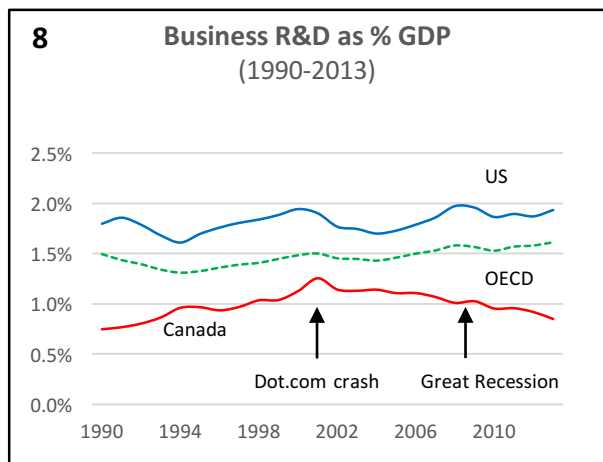
Canada’s low-innovation equilibrium

The importance of innovation for business competitiveness and for national (and provincial) economic growth appears to be undeniable. Yet Canada has always been a laggard on virtually every



standard indicator of innovation, while Canada’s companies and economy have, on the whole, done remarkably well by international standards.⁹ How is this to be explained? And does it mean that innovation is perhaps not so important after all?

The answer to the first question is that Canada has had the unique good fortune of sharing a continent with an innovation colossus and the lead horse in the world economy. In the integrated North American economy, Canada has generally occupied an upstream role as a commodity supplier or as a host to technologically-advanced U.S. subsidiaries (Fig. 7). In neither of these roles was innovation a high strategic priority. The “innovation”—whether in advanced

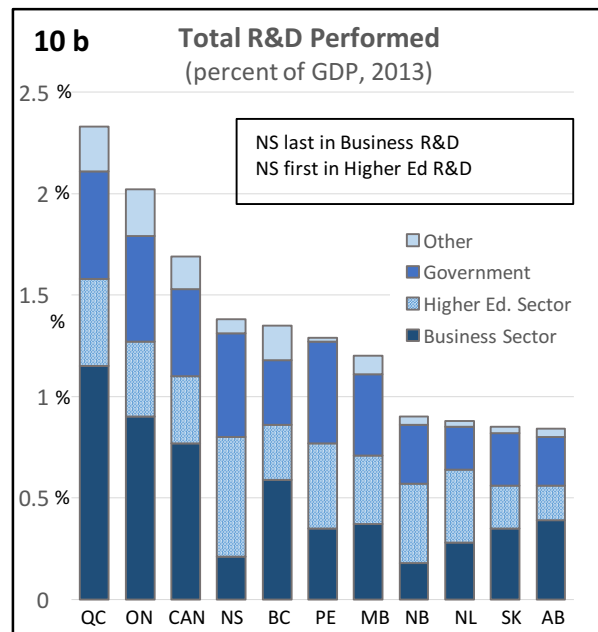
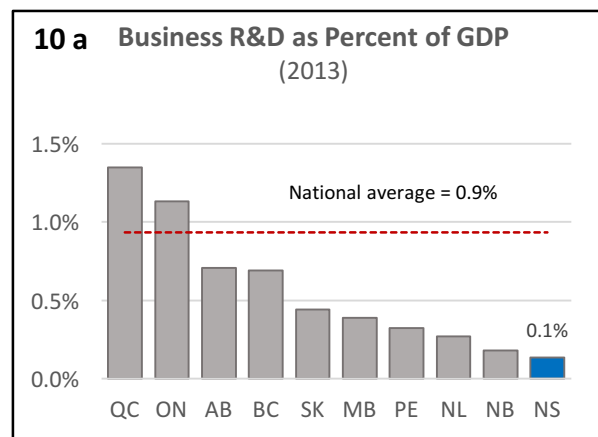


⁹ The growth of Canada’s GDP per person has kept pace, on average, with that of the US despite much slower productivity growth. The latter has been precisely counterbalanced by much stronger workforce utilization in Canada. The problem now is that Canada’s employment rate (jobs as a percentage of the population) cannot increase much more, particularly with the looming demographic headwind. Thus Canada, like Nova Scotia, will have to rely increasingly on productivity growth to deliver increasing living standards together with the growing tax base to finance public services without having to resort to increasing, and unsustainable, tax rates.

technology, business processes, or market development—was largely provided, “second-hand” as it were, from the United States. There have of course been many exceptions, including world leaders in their time like Nortel and BlackBerry. But compared with most of the advanced countries in the OECD group there have been relatively few Canadian-owned multinationals in the most technologically-advanced industries; Canada’s resource-based exports have had remarkably little value added; and business R&D has lagged far behind not only the U.S. but also the OECD average (Fig. 8). And the gap has been widening.

Despite this, the average profitability of corporate Canada overall has matched that of the U.S. in relative terms (Fig. 9). This appears to be due to a combination of resource-based profitability (though with plenty of ups and downs); a less competitive domestic market than prevails in the U.S.; and ready access to the world’s most affluent market just to the south. The bottom

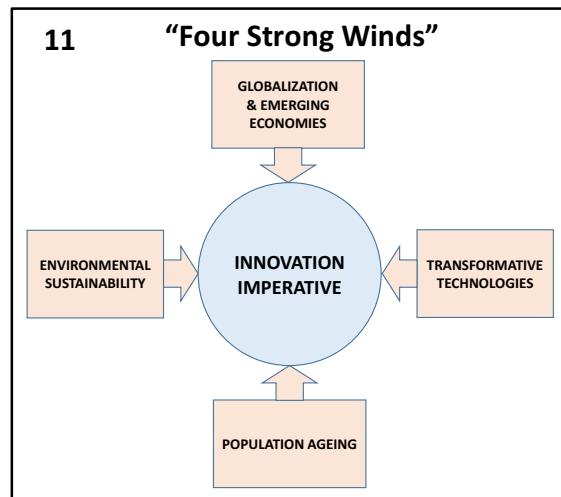
line is that the “bottom line” of Canadian business, on the whole, has not required a strong commitment to innovation. So why take the risk and go through all the effort? The point is—and this cannot be overstated—that *the lack of emphasis on innovation in Canadian business strategy has been entirely rational*. And because it has been rational business behaviour under the circumstances that have prevailed in Canada for at least the last hundred years, it is not easily changed. The same can be said for Nova Scotia where the commitment of the great majority of businesses to innovation has been far less than even the average in Canada. Consider as one telling indicator that Nova Scotia business R&D spending, as a percent of GDP, was the *lowest* among the provinces in 2013, the latest year for which data is currently available (Fig. 10 a). On the other hand, *total* R&D spending in Nova Scotia (relative to GDP) was second only to Ontario and Quebec (Fig 10 b). But that is only because the federal government and Nova Scotia’s universities made up for the paltry R&D performance by business.



Disrupting the low-innovation equilibrium

Businesses both in Canada and in Nova Scotia have been “rationally apathetic” about innovation—though always with important exceptions— and yet have been successful enough over the years. Can that continue to be the case? If the answer is yes, then it will be very difficult for public policy to have much impact in convincing most businesses to become more innovative.¹⁰ This would be particularly problematic for Nova Scotia because the province needs a big innovation push from its business sector to boost the productivity of the economy as a whole so as to offset the severe demographic drag Nova Scotia faces.

It is fortunate, in a sense, that the conditions that have sustained Canada’s low-innovation equilibrium are being disrupted by four global megatrends—Emerging Economies; Transformative Technologies; Environmental Sustainability; and Population Aging—each of which will favour those businesses that innovate and punish those that do not (Fig. 11). These megatrends are still gaining momentum and are of particular significance for Canadian and Nova Scotian business strategies in view of our out-sized reliance on the North American market; lagging SME investment in information technology; prominent environmental footprint of our resource-heavy industrial base; and aging population, particularly of course in Atlantic Canada. A severe disruption of Canada’s and Nova Scotia’s comfortable low-innovation equilibrium is in prospect. (The following observations are stated in the broad context of Canadian business, but most apply with even greater force and relevance to Nova Scotia.)



Emerging economies

While the United States will remain our principal economic partner and will be an economic powerhouse for the foreseeable future, the locus of global *growth* will continue to move toward Asia. Consequently, the greatest economic opportunity is shifting from a market (North America) where Canada has enjoyed unique advantages of geography, language, and business culture toward markets where we have little established position and where we face intense competition from well-positioned firms in Japan, Korea, Australia, Europe and, not least, the U.S. itself which is increasingly focused not only to the east, but also south.

¹⁰ The Lamontagne Senate Committee report in 1970 (*A Science Policy for Canada, Vol 1*) noted how resistant Canada’s business sector was to decades of attempts by policy makers to induce greater innovation. “Since 1916 [...] the main objective of Canadian science policy has been to promote technological innovation by industry [...] Almost every decade since the 1920s has witnessed renewed attempts by successive governments to achieve it, but on the whole they have all failed.” Forty-five years later the observation still rings true.

Canadian business on the whole, but with notable exceptions, has not developed a *global* trading perspective. The dearth of Canadian multinationals, even in the resource sectors, is one striking consequence. If Canada is to compete effectively in the emerging global growth markets—where we lack established access to the new supply networks, let alone to end-users—we will have to develop a much larger stable of globally-oriented multinationals, much as the Scandinavians, Swiss, Dutch, and Koreans—countries that lacked an adjacent colossus to depend on—were long ago compelled to do.

Transformative technologies

Information technology is transforming virtually every aspect of economic and social behaviour. This is rooted in the continuing exponential improvement in the performance-to-cost ratio of microelectronics and related technologies. A tipping point appears to have been crossed in which computer power is now a global commodity resident in the “cloud”, and genuinely useful artificial intelligence finally promises to replace countless tasks that until very recently were believed to require uniquely human capabilities—e.g., driverless cars, flexible robots, query-response based on natural language. No business model will be immune. Fortunately, Canadians are among the leaders in digital skills; our supporting infrastructure is generally good (though not world-leading); and we have considerable business strength in many sectors of the information and communications technology (ICT) industry. Nevertheless, Canadian SMEs invest much less per worker in ICT than their counterparts in the US and several other advanced countries. The gap is especially large in software and is of concern because software applications are a leading driver of productivity growth.

Environmental Sustainability

As steward of a vast territory and as a major producer of many natural resources, Canada bears a dual ethical and commercial responsibility to be among the world leaders in the transition to environmentally sustainable growth. The challenge to resource-based industries is two-fold—first, from growing public opposition to practices perceived to be unsustainable; and second, from *substitutes* that are developed in response to high prices, concern over security of supply, or to reduce environmental impacts. In both cases the threats can be mitigated, and transformed into new market opportunities, only through innovation. The potent incentive to innovate created by this combination of threat and opportunity will still have to overcome the inertia of ingrained habits in the resource industries. Stronger policies will be needed to stimulate both producers and heavy users of natural resources to make a substantially greater commitment to innovation. A combination of major public investment in research and demonstration and carefully thought-out regulation and targeted incentives are required.

Population Aging

As a population ages the *relative* size of the workforce diminishes, making labour relatively scarcer and therefore more expensive. While off-shoring, immigration, and use of temporary

foreign workers can mitigate the effect, these solutions face resistance beyond a certain point that varies from country to country. The more fundamental response is to innovate to save labour and this will be accomplished increasingly with IT-based applications, primarily in robotics and artificial intelligence. This explains why Japan—a country at the leading edge of the aging trend—is also a leader in robot design and implementation. There is, on the other hand, the worrisome possibility that labour-saving innovation will be so successful that even aging populations will end up with a growing labour surplus. The ultimate equilibrium is impossible to foresee but what is certain is that the application of labour-saving innovation will have a major impact on future competitiveness and productivity growth.

These four megatrends, as they filter through into the bottom lines of Nova Scotia’s businesses, can be expected to create stronger incentives to innovate than has ever been the case before. The low-innovation equilibrium will be disrupted simply because that behaviour will become inconsistent with profitability and business survival. The transition to a more innovative state of mind will nevertheless not be easy for many Nova Scotia businesses because of the strong temptation to deny the warning signs and stick with what you know, and because many of the skills required for successful innovation are lacking. An innovation strategy for Nova Scotia will have to include measures to foster and facilitate the *transition* that businesses will be required to make. Businesses themselves, out of sheer necessity, will need to be committed partners in the process.

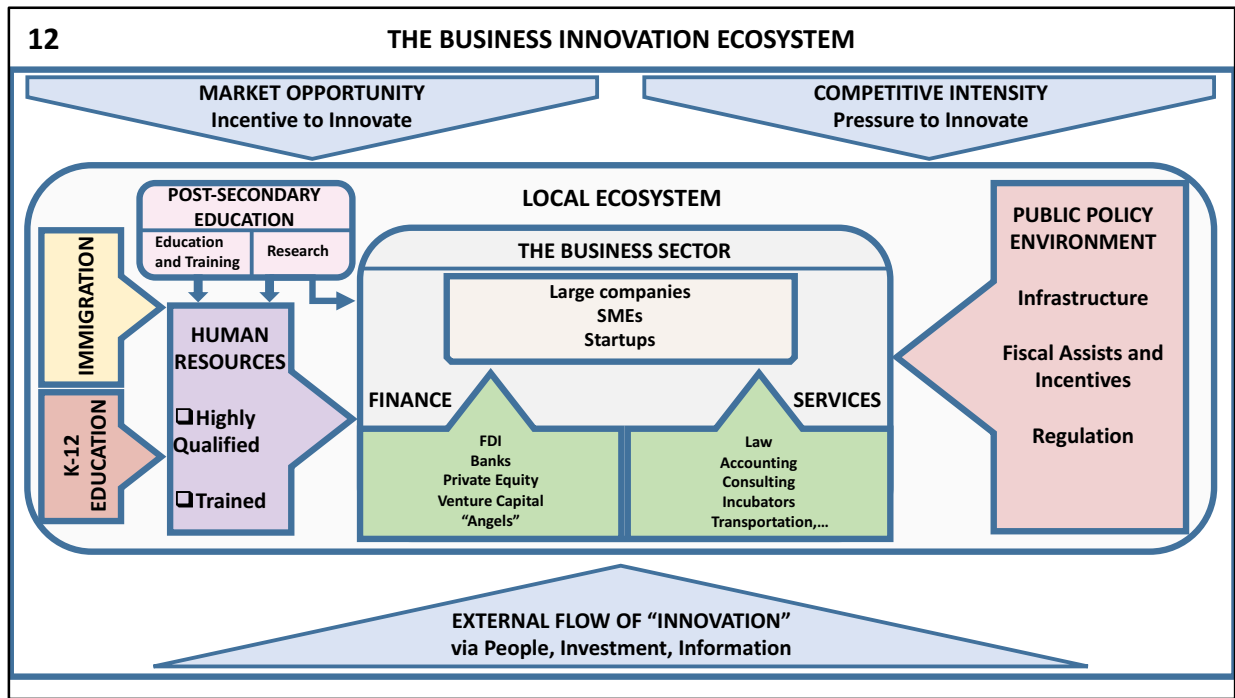
Elements of an innovation strategy for Nova Scotia—the structure of this report

This report is concerned with innovation as an economic process; as the principal means by which the productivity and overall performance of Nova Scotia’s economy can achieve its potential. In such a broad context, innovation is an exceptionally complex system with many interacting organs: entrepreneurial talent, basic and applied researchers, risk-tolerant investors, an array of professional services and specialized infrastructure, and a facilitating public policy environment. By analogy with interacting biological phenomena we have come to conceptualize the innovation process as an “ecosystem” to put the emphasis on its interdependence. And just as in a biological ecosystem, the interdependence sometimes takes the form of competition and sometimes the form of co-operation.

Because an innovation ecosystem is so complex there is no standard way to define, let alone predictively model, all the interacting parts. It is nevertheless helpful to begin with some map of the key features of every innovation ecosystem, so we have come up with our own in Fig. 12. The focus in the centre of the diagram is the business sector—think of Nova Scotia’s economy comprising a range of companies (“species” in the ecosystem) from large and established to tiny and just starting, and across a spectrum of industries. They draw on a variety of financial species, from angel investors to commercial banks, and on a broad range of specialized services—patent

lawyers, consultants, engineers, machine shops, IT experts, and many others. These too are businesses and must also innovate to survive.

The business species in the ecosystem exist in a surrounding environment that can either stimulate or stymie innovative behaviour. The diagram depicts, on the left, the impact of essential nourishing elements—highly-qualified talent; well-trained people; and channels through which research results can be accessed from post-secondary institutions either directly from collaboration with faculty or via students as interns or employees. Depicted on the right of the diagram is the public policy environment which, in addition to supporting financially the research and human capital resources of the ecosystem, has a critically important influence through the provision of infrastructure, financial assistance and incentives, procurement, and regulation.



The ecosystem functions in a much broader environment; the “climate” as it were. Of overwhelming importance is the combined influence of market opportunity and competitive pressure—the yin and yang of opportunity and challenge—shown as external forces impinging from the top of the diagram. When all is said and done, these are the great motivators of business innovation. Too much competition, for example, and people give up and try something else; too little and they often lay back.

Finally, a healthy innovation ecosystem must be like a sponge; very efficient in absorbing innovation from the global surround. The sponginess depends on the willingness and ability of the actors within the ecosystem to explore the external environment, to discover the best ideas,

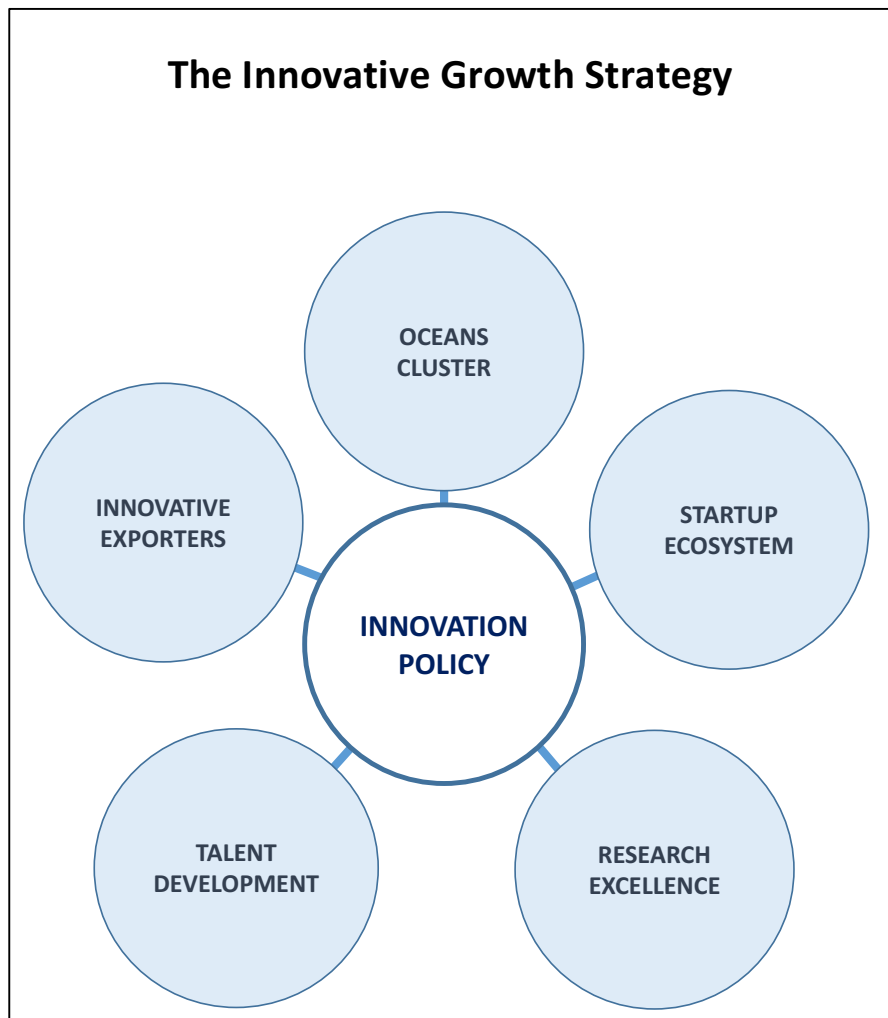
technologies and practices, and then to improve and adapt them to the local ecosystem. “Swipe from the best and then adapt” in the words of management guru, Tom Peters. Again, the Honeycrisp apple story is telling.

Unfortunately, there is no predictive science of innovation ecosystem behaviour; no prescription that if one tweaks a particular element—say, spending “X” dollars to subsidize R&D—the ecosystem will respond in any very predictable way. But fortunately, the long accumulation of experience in Nova Scotia, in Canada, and around the world, suggests that if government attends to the health of certain key elements of the ecosystem, it can be expected to be a powerful source of growth and prosperity. Specifically:

- The basic education system has to prepare its students for the world they will encounter; which today is a world in which computer “literacy” and math skills are essential.
- There must be a post-secondary education system that imparts advanced skills and is capable of performing research that meets a global standard of excellence.
- There must be an environment (a sub-ecosystem) that can nurture the innovative startups that will enable the economy to take advantage of new technological and social opportunities.
- There must be policies and programs that encourage established businesses (which account for the great majority of jobs and income) to become more innovative. Nova Scotia’s exporters are on the front lines of global competition and global opportunity, and therefore have the most to lose or gain from innovation.
- Finally, there will always be one or more special features of an innovation ecosystem that reflect exceptional local advantages. In Nova Scotia’s case it is the ocean, which over generations has induced a set of specializations, infrastructure, and businesses that constitute a particular competitive advantage. The advantage attracts people and investment and eventually an innovative “cluster” emerges that, with further deliberate nourishment, can become a major economic driver for a region.

These considerations have shaped the approach taken in this report to propose a comprehensive, integrated innovation strategy for Nova Scotia that is tailored to the circumstances of the province’s innovation ecosystem. The strategy is developed in the following six chapters, after which the recommendations from each are collected, for convenient reference, in a concluding section that serves as an Executive Summary.

- Chapter 1 Preparing the Talent for an Innovative Economy
- Chapter 2 Building up Nova Scotia’s Research Excellence
- Chapter 3 Nourishing the Startup Ecosystem
- Chapter 4 Growing Innovative Exporters
- Chapter 5 Developing a World-class Oceans Cluster
- Chapter 6 Keeping Government Focused on Innovation
- Executive Summary of Recommendations



Chapter 1 PREPARING THE TALENT FOR AN INNOVATIVE ECONOMY

“Hide not your talents, they for use were made, What’s a sundial in the shade?”

— Benjamin Franklin

Innovation originates from curious, creative, motivated, talented people. That is why an innovation strategy for Nova Scotia must begin with a commitment to develop top-flight human resources beginning in the pre-school years and continuing through post-secondary opportunities and a broad range of work-integrated learning. The payoff from an ambitious commitment to talent development is a Nova Scotia that will have a more productive and competitive economy; be a magnet for investment; be more inclusive; and a resilient society that is well-equipped to adapt to whatever opportunities and challenges the future brings. In short, human talent is the foundation of everything Nova Scotia hopes to achieve.

Making Nova Scotia a Global Leader in Computer Literacy

Broad-based computer skills are the literacy of the 21st century—the “C” that now must be added to the traditional 3Rs. The importance of computer literacy cannot be over-stated. There are at least three reasons.

- Information and communications technology (ICT) has become all-encompassing—for example; between 1995 and 2015, the number of internet users globally grew more than 65-fold from 45 million to 2.9 billion, and mobile phone users from 80 million to more than 6 billion¹¹. Fluency in ICT use has become table stakes in the economy and society.
- There is enormous demand for a computer-literate workforce, with millions of jobs that require ICT skills projected to be unfilled worldwide over the next decade.
- Progressive education in computer literacy both develops, and is complemented by, cognitive skills such as logic, creativity, teamwork, and general problem-solving, which are among today’s most sought-after skills.

This explains why a broadly computer literate population is key to Nova Scotia’s prosperity and will be a significant attraction for future investment in the province. It is essential that instruction in grade school be broadened beyond simply “coding” to also include creativity and logical thinking, and the application of these skills in science, engineering and the arts. Universal digital literacy will not only be a “future-proof” asset for the Nova Scotia economy, but also an opportunity equalizer for disadvantaged groups that would otherwise face increasing challenges in the job markets of tomorrow.

¹¹ World Bank (2016), Internet users (per 100 people). Accessed at <http://data.worldbank.org/indicator/IT.NET.USER.P2?end=2014&start=1990&view=chart>

Nova Scotia has already invested \$1 million in computer facilities in schools, and established coding-based skills as an essential learning outcome for students in the early grades. This commitment needs to be expanded and accelerated to establish the province as one of the global leaders in computer education in grades P-12. To become a leader, computer literacy will need to be complemented with a focus on the intersection of creative and design thinking, logic, problem solving, as well as “old-fashioned” literacy and numeracy. These basics are foundational for the STEM skills (Science, Technology, Engineering, Math)—and the complementary role of the creative arts and design— that are already in high demand and destined to become more so. This is not primarily about teaching word processing, spreadsheets or even coding; it is about fostering creativity, teamwork, critical thinking, and problem-solving. From this perspective, the students are the creators and authors, not the users.

1A

**Coding as a Tool to Teach Creativity, Logic,
Reasoning, Collaboration and Teamwork**

Many so-called “computer coding” lessons will NOT involve computers – especially in the very early grades - but focus on creativity, logic, reasoning, collaboration and teamwork.

- **Building Blocks.** Building blocks are a great learning toy. Stack them up and encourage counting. Build a tower using blocks of different heights and ask which tower has the most blocks. Children can be asked to line up a group of blocks that have 1 green block for every 3 yellow blocks, and various other sequences. They may then expand to having 20 blocks with 10 different colours, and be asked to stack them as high as possible, with no blocks of the same colour touching each other—a different take on Rubik’s Cube.
- **Instructed Map Route.** Mark on the floor the starting and ending points, and set a couple obstacles on the route. Have a child close eyes and follow the instructions from another one. The instructions (a simple algorithm) are like these: step forward 3 steps, turn left and walk 2 steps, turn right and walk 6 steps, ... When playing, remember to point out that the number of steps should be adjusted for the size of the steps. For older kids, you can move this activity onto paper, with a maze and instructions on going through the maze.
- **If-Then Game.** If-Then is what’s called a conditional statement in programming. The program queries if one condition exists, then it commands it to do something. It can be as basic as a True or False question and answer or it can prompt an action. Students are in a classroom or outside and there is one Programmer and everyone else is a Computer. The Programmer stands in front of the Computers and gives them his command. If I ____ (fill in the blank), then you ____ (fill in the blank); e.g. “If I turn in a circle, Then you do jumping jacks.” It can evolve to If-Then-Else statements: “If I raise my right arm, Then you raise your left arm, Else raise your right foot.” So if the Programmer just stands there and does nothing, the Computers should all be raising their right foot.
- **The Learning Carpet.** The learning carpet (a square carpet with a grid on it) out in the middle of the classroom. Students write a simple algorithm using the following language to move a stuffed animal to a predetermined spot on the carpet using the following commands:
 - FW – forward
 - BW – backward
 - LT90 – left turn 90 degrees
 - RT – right turn 90 degrees

Students write down the instructions needed to get from the beginning to the stuffed animal.

There is still only a small number of jurisdictions that have instituted compulsory computer literacy courses through all grades—e.g., the UK, British Columbia, the City of Chicago (Box 1B). So Nova Scotia is positioned to be among the leaders, both in Canada and internationally, provided the government’s existing commitment is made a priority for accelerated development. While there are risks in being among the pioneers—which is why some advocate a “follower” strategy for Nova Scotia—leadership in this case can be expected to produce a significant *reputational* advantage for the province as an innovator in one of the most important initiatives in the 21st century. To earn this benefit will nevertheless require significant up-front investment for equipment, curriculum development, and particularly for teacher training which, in view of the continuing rapid changes in information technology, will require regular up-dating.

1B Some Pioneers of Coding in Public Schools		
Nova Scotia	British Columbia	United Kingdom
<p>Nova Scotia is a Canadian leader in integrating coding into the public school curriculum. The Province has committed to integrating coding across all grades. Primary to grade 3 students work with simple, programmable robots, while students in grades four through six will use software and a variety of learning aids to support the development of problem-solving and critical thinking skills. Middle school and high school students will engage with multiple programming languages.</p> <p>The Province is investing \$1 million to support the new curriculum in 2016-17. This money will be used primarily to purchase equipment (e.g., “Beebots”—programmable robots that look like bumblebees).</p>	<p>BC unveiled its new “Applied Design, Skills, and Technologies” curriculum in early 2016. Students in the primary grades will be given the opportunity to build computational thinking skills, while middle school students will learn to work with visual programming languages. All students will complete a core module of computer programming before the end of Grade 9.</p> <p>BC has made an initial commitment of \$6 million: \$2m for teacher training, \$2m for implementation of the new curriculum, and \$2m to purchase equipment. Inequity of access remains a concern in a province where many rural communities lack reliable connections to the internet, and where many remote schools have only very basic computer labs.</p>	<p>The United Kingdom released a new “ICT” curriculum in 2014. Training in “coding” begins at age 5, and students are debugging programs by Stage 2 of the program (ages 7-11). By Stage 3, pupils are learning simple Boolean logic and will have gained familiarity with two or more programming languages.</p> <p>The British program is more ambitious in its aims than those found in Canada. However, funding for the implementation of the new curriculum has been limited: in 2013-14, the government set aside just £1.6 million for teacher training.</p>

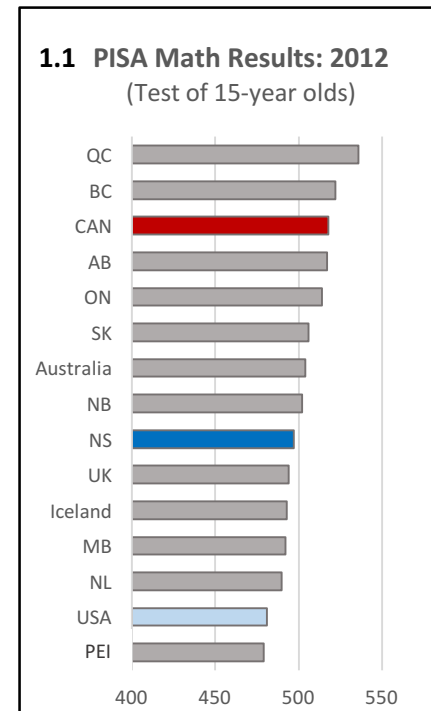
A corollary requirement is consistent access to high-bandwidth internet connections throughout the province. In 2006, the \$75 million Broadband for Rural Nova Scotia program sought to provide reasonably high-speed access (1.5mb/s) to every civic address. The investment costs were shared among the federal government (\$14.5M), the province (\$19.5M) and the companies that were contracted to provide the services (\$41M). The program was a good start but further investment is clearly needed both to increase transmission speed (e.g., to at least 15 mb/s) and to

provide truly comprehensive rural coverage. Put simply: the availability and quality of broadband internet access is today regarded as basic infrastructure to enable social and economic activity.

Enhancing Math Skills for Nova Scotia's Youth

In addition to computer literacy, the STEM subjects underpin an increasing number of occupations that are in high demand now and anticipated to be in the future—for example; skilled trades, engineers, computer scientists, data analysts, and health care professionals. In view of the importance of quantitative skills for good jobs, parents should be concerned that too many high school students are either not taking or are dropping out of math options. This can be crippling for future opportunities. It is ironic that so many parents are enthusiastic boosters of sports participation, and make large sacrifices to enroll “John or Jane” in highly competitive programs, yet give little encouragement to a subject like math education that could have a far more significant impact on their child’s future.

That said, if we expect today’s students to be more committed to math and related subjects, they need to be well taught by teachers who have the appropriate professional qualifications, as is required, for example, in Québec. Based on many years’ evidence from the PISA (Program for International Student Achievement) evaluations of 15-year olds around the world, Nova Scotia’s math education is sub-par among the provinces (Fig. 1.1). This is at least circumstantial evidence that the quality of mathematics instruction needs to be improved. Québec students score close to the top in the world, demonstrating the pay-off from teachers that are professionally trained in math.



1.1 Recommendation on Universal Computer Literacy

- a) To establish Nova Scotia as having among the world’s most computer-literate populations, continue to enhance and accelerate coding and related computer skills in grades P-12, with a primary focus on using this as a tool for students to develop creativity, logical reasoning, teamwork and problem-solving skills. This initiative will need to be supported with significant continuing investment in teacher training and facilities.
- b) Collaborate with the federal government and private ICT firms to provide greater access throughout Nova Scotia to higher speed and quality broadband internet service.

The foregoing recommendation is foundational, but should be regarded as only one, albeit extremely important, aspect of a broader re-tooling of the basic education system to make it relevant to the learning and innovation skills required to succeed in the digital age. To this end, there is a need, for example, for:

- enhanced mathematics instruction and support;
- learning that encompasses creativity, teamwork, critical thinking and problem solving;
- “maker-spaces” and many more hands-on technology learning experiences;
- entrepreneurial opportunities for grade school students (e.g., through workshops and camps) to increase awareness of the nature and benefits of entrepreneurship; and
- more effective practices in turning around low-performing schools. This should lead to better access to post-secondary institutions for students from such schools with the help of programs to improve their readiness to succeed, particularly for under-represented groups in Nova Scotia—specifically, First Nations, African Nova Scotians, and persons with disabilities.

Philanthropists and businesses can make a significant contribution to innovation in education. For example, the \$650 million U.S. “Investing in Innovation” Fund includes investments by 12 Major Foundations which contributed \$500 million to support innovation in education, including STEM and computer literacy, as well programs to increase high school graduation rates and college enrollment and completion rates. If private philanthropic funds were to be made available in Nova Scotia to encourage innovation in education, it is important that the provincial government be receptive to the opportunity and be prepared to “experiment.”

Providing Work-Integrated Learning Opportunities for all Post-secondary Students

Work-integrated learning (defined in the Annex to this chapter), as well as post-graduation employment programs, generate multiple benefits for students, new graduates and employers. Such opportunities:

- provide practical job experience which has become an essential complement to formal learning programs in an ever-broadening range of fields;
- introduce new methods and skills to small and medium-size enterprises, enabling these companies to become more productive and better prepared to undertake R&D and ambitious market development;
- are particularly effective in transferring ICT skills to small businesses—a group of companies that generally under-invest in computer-based technology; and
- give employers the opportunity to identify talent and “fit”, which often leads to employment of students in existing positions or the creation of new positions.

Nova Scotia should strive to have the most comprehensive work-integrated learning experiences provided by post-secondary education institutions (PSEs) in Canada. The goal should be to

provide all university and college students in the province with the *opportunity* to participate in such programs. Post-secondary institutions currently provide many work-integrated learning experiences but would be unable to universalize the opportunity within existing programs and administrative resources. More ambitious initiatives need to be developed in collaboration among the PSE institutions, business and government.

1.2 Recommendation on Work-Integrated Learning

To fulfill an ambition for Nova Scotia to be a talent leader in Canada, post-secondary institutions in collaboration with business and not-for-profit organizations should ensure that all students have the opportunity for a work-integrated learning (WIL) experience, and the Province should increase funding for approved WIL programs to match demand.

Enabling SME Innovation with Highly-Qualified Graduates—“Innovate to Opportunity”

Co-ops, internships and other forms of work-integrated learning better prepare today’s student for the workplace, but too often this is not enough to land that critical first full-time job. The challenge is particularly daunting in Nova Scotia as evidenced by the province’s chronically high level of youth unemployment—15% in 2015 as compared with 13% nationally. The government’s new “Graduate to Opportunity” program (Box 1D) is a well-designed initiative to address the problem and is reportedly over-subscribed with business demand. The program should be substantially scaled up depending on demonstrated success as further experience accumulates.

<p>1C The Nova Scotia Co-Op Education Incentive</p> <p>The Co-op Incentive provides wage assistance to private sector, government-funded and non-profit organizations offering career-related work experiences for post-secondary co-operative students. Employers pay students a minimum of \$15.00 per hour plus 4% vacation pay, and the program will reimburse \$7.50 per hour to a maximum of 40 hours per week. Employers participating in IRAP and qualifying for an SR&ED tax credit are eligible for an “R&D Incentive” and may receive up to \$10.00 per hour. The demand from business for co-op positions has been very strong and exceeds currently allocated provincial funding of about \$2.3 million.</p>	<p>1D Graduate to Opportunity</p> <p>“Graduate to Opportunity” provides salary contributions to employers in Nova Scotia in order to offset the cost of hiring someone who has graduated within the previous 12 months from a Nova Scotia university or college. The objective is to help recent graduates find career opportunities to encourage them to stay and work in Nova Scotia. Eligible employers must also either have fewer than 100 employees, be a recent start-up, or a social enterprise, non-profit, or charitable organization. Eligible positions must be new, permanent and full-time with a minimum salary of \$30,000. The program funds 25% of the new employee’s salary in the first year and 12.5% in the second year (up to an annual salary of \$60,000). Applications are accepted on a continuous basis. Launched in 2015, the Province committed \$1.6 million in the first year of the program, \$3.2 million in the second year, and \$6.5 million for the third.</p>
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Highly-qualified graduates as “vectors of innovation”

Employers can potentially benefit just as much as graduates from programs to encourage hiring those with advanced skills. For example, a new graduate with a Master’s degree in a technical subject, and with a yen for business, can have a transformative impact on a smaller enterprise that has been reluctant to invest in innovation or explore a new market opportunity. The latter pattern is all too common among Nova Scotia SMEs, particularly in resource-based and other more traditional sectors. This reluctance to innovate is a significant source of Nova Scotia’s chronically weak export performance (see also Chapter 4). Entrenched conservative behavior has nevertheless proven very hard to change because, from the business owner’s perspective, it may be entirely *rational* to shun the risk of innovation—e.g., investment in a costly state-of-the-art piece of equipment or undertaking even a modest amount of R&D. While the business might be performing well below potential, if it is still somewhat profitable, and can support the owner’s lifestyle, then innovation may appear to be a less attractive response than simply hunkering down, cutting costs and perhaps looking toward retirement.

How could this “rational” reluctance be changed so as to cause far more Nova Scotia companies to embrace innovation and, by so doing, improve the performance of the economy at large? One potentially powerful initiative would be to “infect” the business with highly-qualified talent trained at the leading edge of a relevant field, equipped with a global outlook, young enough to see a bright future, and lacking the experience to know that “it can’t be done”. People with this kind of talent and outlook constitute the most effective means of technology transfer. Like a benign virus, they are vectors to spread innovation throughout the economy.

Government can encourage the replication of the “innovation virus” through a program that creates a sufficiently potent incentive for SMEs to hire appropriately qualified young graduates, typically (but not necessarily) at the Master’s level. Such an “Innovate to Opportunity” program could be modeled as an extension of Graduate to Opportunity. The support should encourage employment for an extended period—e.g., at least three years—in order to be effective in changing the behavior of the host business. The support would have to be quite large initially to meet the salary expectations of highly-qualified talent and to encourage uptake by the type of company being targeted—i.e. those with potential to benefit substantially from innovation but reluctant to take the risk. The program should be restricted initially to a few high priority sectors to establish its effectiveness. In combination with the “SME Export Accelerator” proposal described in Chapter 4, Innovate to Opportunity could have a genuinely transformative impact on the ambition, competitiveness, and export performance of many Nova Scotia SMEs that presently are laggards when it comes to innovation and exporting. It can also be expected that some portion of the hires would remain with the host company indefinitely and eventually be candidates for CEO or owner succession.

1.3 Recommendation on Innovate to Opportunity

To encourage SMEs to become more innovative and export-oriented, the Province should create an “Innovate to Opportunity” program that would:

- a) Provide multi-year support to selected SMEs that hire, on a permanent basis, recent highly-qualified graduates of Nova Scotia post-secondary institutions (typically at the Master’s degree level). Support should be for a minimum of three years to provide time to have a meaningful impact on host company innovation, and front-loaded to increase the incentive to hire.
- b) Select eligible companies, among applicants, based on potential to become exporters or to significantly improve existing export performance.
- c) Co-ordinate with the “SME Export Accelerator” program (Recommendation 4.1) to increase the likelihood that a company is selected for both programs since they are strongly complementary. (Simultaneous selection should not, however, be a requirement of either program.)

Promoting Diversity and Job-readiness in Technology-intensive Occupations

The STEM subjects underpin an increasing number of occupations that are in high demand now and in the future—for example; skilled trades, engineers, computer scientists, data analysts, and health care professionals. Meanwhile, the employment rate among “under-represented” groups in Nova Scotia—specifically, First Nations, black Nova Scotians, and persons with disabilities—is unacceptably low in general and even more so in occupations that require STEM skills at the high school level or beyond¹². There is a double cost as a result—groups that are already disadvantaged miss out on opportunities for many of the good jobs of the future, and technology-intensive occupations that face looming labour shortages have less potential talent available.

These shortcomings can be at least partly addressed with programs that combine employment opportunity with tightly-targeted training for job readiness in occupations that require various levels of ICT competence. The U.S. TechHire program (Box 1E) provides one model and demonstrates effective training approaches that do not require a post-secondary degree or certificate. If viable paths to employment can be demonstrated for occupations that require ICT skills, currently under-represented groups will come to see themselves in these roles. This will stimulate the motivation to master STEM subjects in high school and to increase participation in related college and university programs, creating a virtuous circle of reinforcement leading to a fairer and more inclusive society.

¹² Let’s Talk Science. Spotlight on Science Learning: The High Cost of Dropping Science and Math. 2013. p. 13.

1.4 Recommendation on Diversity and Job-readiness--“Atlantic TechHire”

The federal government, through ACOA, should work on an Atlantic-wide basis with the private sector, departments of education, and post-secondary institutions to develop targeted training programs to encourage and increase employment in ICT-intensive occupations for under-represented groups, including First Nations, African Nova Scotians, and persons with disabilities.

Attracting Talented Immigrants

Nova Scotia, and Atlantic Canada generally, need more immigrants and international students both to enhance the base of technical and entrepreneurial skills and to help offset the economic impact of a declining, ageing population. Skilled talent from abroad contributes a diversity of skills and perspectives as well as valuable international networks.

1E

Tech-Hire

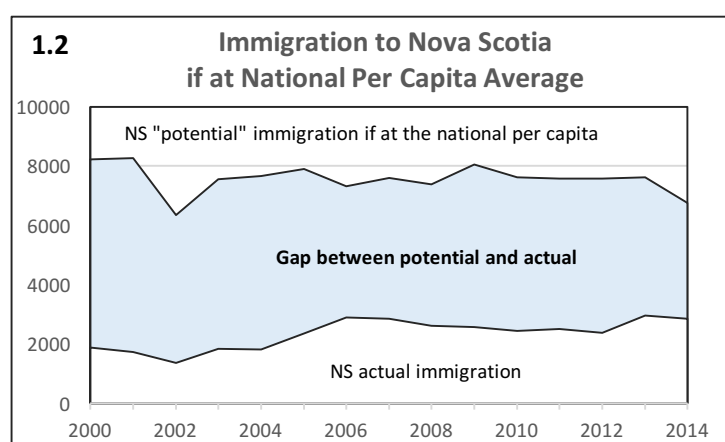
TechHire is a multi-sector initiative in the U.S. that matches employers in need of ICT workers with the trained people they are seeking. It is being piloted in 20 communities in regions with more than 120,000 technology job vacancies and more than 300 employer partners. TechHire works with these companies to find new ways to train, recruit and place applicants in jobs through fast-track ICT training. Because many of these jobs do not require four-year ICT degrees, the training programs can often be delivered through nontraditional approaches like “coding boot camps,” and high-quality online courses that train workers for a well-paying job, often in just a few months. The U.S. Department of Labor is launching a competition to support innovative approaches to training and employing low-skill individuals who face barriers to training and employment including those with child care responsibilities, people with disabilities, disconnected youth, and workers with limited English proficiency. This grant competition will support the scaling up of evidence-based strategies such as accelerated learning, work-based learning, and registered apprenticeships.

The challenge for Canada is to balance the need for a rigorous immigrant vetting system with one that is also easy to navigate and produces timely decisions. The latter characteristics appear to have been eroded to the point where Canada urgently needs to implement more streamlined visa and immigration procedures that will be competitive with those being introduced in leading jurisdictions around the world—e.g. the UK “Tech Nation Visa”, the Netherlands “Highly Skilled Migrants” visa, Israel’s “Innovation Visa for Foreign Entrepreneurs”. Such a new procedure, targeted specifically at recruiting exceptional talent to Canada, should be complemented with a redoubled effort by Atlantic region universities to attract many more international students, who can also be a pipeline of talent for a new visa and immigration program. Australia, for example, has more than twice as many international students *per capita* as Canada¹³.

The greatest benefit of immigration for Nova Scotia’s economy lies in the potential to attract more entrepreneurs and talented employees to create or start businesses or work for export-

¹³ In 2016 Australia reports hosting 493,000 international post-secondary students or 20.3 per 1,000 population, whereas the comparable numbers for Canada (in 2014) were 336,000 and 9.5 per 1,000 population.

oriented SMEs where immigrants' networks and market familiarity can provide significant competitive advantages. Accordingly, the Province has made changes to the Nova Scotia Nominee Program, which falls under the federal Economic Class of immigration and allows Nova Scotia to nominate individuals for permanent residency provided they have the skills and experience to fill the province's labour market needs. In 2015, the Nova Scotia Demand: Express Entry stream for highly-skilled persons in skilled jobs, as well as the Immigrant Entrepreneur and International Graduate Entrepreneur streams (which allow immigrants to start or buy a business) were launched. In 2014, international students became eligible for the Skilled Worker stream.



Immigration has recently been a more positive story for Nova Scotia with more than 3,400 immigrants in the first six months of 2016, or slightly more than the number for all of 2015, which had been a record year. Refugee landings have increased substantially in 2016 (reflecting an influx fleeing the conflict in Syria), and landings under the Provincial Nominee Program are 1,500 for the

first six months of 2016 compared with just under 1,400 for all of 2015. This success can be traced to the efforts of the provincial government and a willing federal partner. In 2014, the nominee allocation was only 700, but was increased to 1,050 in the first half of 2015 and then to 1,350 following demonstrated success. This track record provides justification for the federal government to continue increasing the number of provincial nominees allocated for Nova Scotia.

The goal for Nova Scotia, and for Atlantic Canada generally in view of the severe demographic challenge the region faces, is to become eligible for at least the national average *per capita* number of immigrants (Fig 1.2). The case of Manitoba is instructive, where the cap was increased to 5,000, despite a population only slightly higher than Nova Scotia's. Manitoba realized a 20% growth in immigration and a 9.5% growth in total working-age population from 2006-14, compared with only 5.4% and 2.5% respectively in Nova Scotia.

Nova Scotia is clearly on the right track with its initiatives to attract more immigrants, although there is still a long way to go just to reach the national per capita average. A parallel effort to increase the number of international students that are attracted and retained is the focus of a working group of the "Innovation Team" collaboration between post-secondary institutions and the Department of Labour and Advanced Education. These initiatives will of course be effective and sustainable in rough proportion with the extent to which Nova Scotia's economic prospects improve. An innovation-driven strategy to that end is described in the chapters that follow.

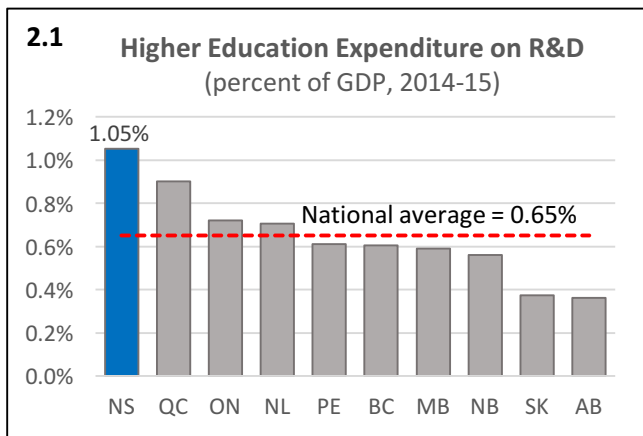
Annex Work-Integrated Learning	
<p>Students in post-secondary education institutions are now being provided with many more opportunities to learn outside of the classroom. Depending on the duration, style, compensation, and objective of the opportunity, the student’s role may fall under any number of types of work integrated learning (WIL). The table below was adapted from the Work Integrated Education matrix developed by the Accountability Council for Co-operative Education in BC and distinguishes the many types of WIL opportunities.</p>	
Types of Work Integrated Learning	
Applied Research	Student is engaged in research occurring primarily in the workplace (e.g. consulting, design projects, public opinion polling)
Apprenticeship	Student engages in a combination of on-the-job training and classroom instruction, typically under the supervision of a licensed practitioner, in order to learn a highly-skilled occupation. A paid position, an apprenticeship typically involves 80:20 workplace to classroom ratio and takes two to five years to complete.
Curricular Community Service Learning	Student works in partnership with a community-based partner to apply their program knowledge to a challenge identified by the community. This is followed by a reflection on the process and the student’s role within the community.
Co-op	Student alternates between academic and paid work terms in a workplace setting related to the student’s area of study. While there is variation among programs related to the amount of hours worked, most co-op programs require work terms to be 30% or more of time spent in academic terms.
Internship	Student works in a discipline-specific supervised work environment for typically 4-12 month periods. Internships take place during or after coursework is completed and are a graduation requirement for some programs.
Practicum/Clinical Placement	Student works under the supervision of an instructor in any field requiring practice-based work experience for certification or a license. Usually unpaid and not typically completed simultaneously with an academic workload.
Other	Work integrated learning experiences that are not incorporated within the academic program include para-professional work, research and teaching assistantships, community service learning, volunteerism, and work-study programs.

Chapter 2 BUILDING UP NOVA SCOTIA’S RESEARCH EXCELLENCE

“I believe in innovation and that the way you get innovation is you fund research and you learn the basic facts.”
 —Bill Gates

Advanced education is a Nova Scotia strength. The province’s 11 post-secondary education institutions currently educate a student body of more than 45,000, almost 20% of whom come from abroad and a third from other provinces, making educational services, in effect, an important export business with considerable growth potential (Box 2A next page).

The province’s universities provide a broad base of research capabilities that is an increasingly valuable asset as economies worldwide strive to translate discovery into innovation, and innovation into growing prosperity. In 2014-15, Nova Scotia’s PSEs performed \$411 million of research and development, including \$175 million funded from external sources.¹⁴



With the provincial government accounting for only \$11.4 million (about 6.5% of total externally funded university research) the great majority of funds come from sources outside the province—e.g., \$109 million from Ottawa—and are thus the equivalent of an export of services. While Dalhousie performs the great majority of PSE research in Nova Scotia—83% (\$145 million) of the externally funded amount in 2014—most of the other universities also undertake

research and graduate education in specific fields. In short, post-secondary research is a major activity in Nova Scotia, disproportionate to the size of the province (Fig. 2.1) and an exceptionally solid foundation on which to build a more innovative and prosperous economy.

This chapter develops in greater detail the reasons why the provincial government needs to do more to complement the federal government’s primary role in funding post-secondary research; recommends a consolidation and re-mandating of the fragmented provincial research funding bodies; and suggests some ways to promote more effective collaboration between PSEs and

¹⁴ 2014-15 is the latest fiscal year for which provincially disaggregated data is available from StatsCan. In that year, Nova Scotia’s PSEs funded 57.4% of their R&D from their own resources (as reported to StatsCan by CAUBO); while 26.6% came from the federal government; 8.9% from business, 2.8% from the provincial government and 4.4% from other sources. Considering only the portion funded by other than PSEs themselves, 62.3% (\$109.2 million) was provided by the federal government and 6.5% (\$11.4 million) by the Province.

Nova Scotia businesses which, to date, have taken far too little advantage of the post-secondary research assets that are close at hand. First; some background as to why strong government support of fundamental research is such an important public investment.

2A Nova Scotia’s Post-Secondary Advantage

Nova Scotia is home to 11 post-secondary education institutions (PSEs), making advanced education the province’s most significant strength in building a more innovative economy. The system currently educates more than 45,000 full-time students in a network of university and NSCC campuses that ring the province, thus providing ready access to a PSE facility for the great majority of Nova Scotians and for their communities.

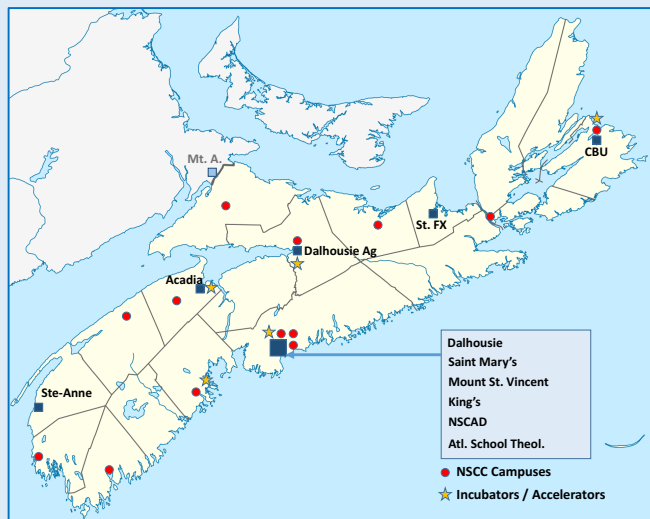
The PSE system, in addition to its fundamental roles of advanced education, research and training is a major employer; a resource of knowledge and specialized capabilities for businesses and communities; and is a magnet to attract talented researchers and students to Nova Scotia from around the world. Moreover, the province’s PSEs play a sometimes decisive role in attracting international firms like IBM and EY to open operations in the province, knowing they can depend on PSEs to supply the talent they need.

Nova Scotia’s PSE institutions are by far the largest performers of R&D in the province, accounting for \$411 million in 2014-15, of which \$175 million came from sources other than the internal resources of PSEs themselves, and including \$109 million from the federal government. Dalhousie accounted for about 83% of externally funded research in 2014-15 and is the only Atlantic Canada member of the U-15 group of top research universities in Canada.

The 2016 “Graduate Retention Study” on behalf of the Association of Atlantic Universities found that for PSE grads from across the Atlantic provinces (based on a sample of 4,643):

- Among university graduates, 77% took an undergrad degree, 13% a Master’s, 2% a PhD, and 8% some other
- 85% of college grads and 58% of university grads had participated in work-integrated learning
- Average income expectations for a first job were \$49.1 thousand and \$39.5 thousand for university and college grads respectively
- Three-quarters of international grads would remain in the province if given a choice
- Among all grads, 82% would remain in their province of study if an attractive job offer were available.

Nova Scotia PSE Enrolment (2015-16)	
Institution	Number
Dalhousie	18,845
NSCC	10,951
St. Mary’s	7,209
St. Francis Xavier	5,286
Acadia	4,486
Mt. Saint Vincent	3,710
Cape Breton	3,022
King’s College	1,019
NSCAD	826
Univ. Sainte-Anne	603
School of Theology	111
Total (full-time)	45,117



The Public Payoff from Investment in Fundamental Research

In a now famous memorandum to US President Truman in 1945¹⁵, the presidential science advisor, Vannevar Bush, made a compelling case for the peacetime expansion of government support for fundamental research in science, and advocated creation of a funding agency that was to become the U. S. National Science Foundation. Inspired by the pivotal contribution of science and related technology to the war effort, Bush wrote that basic research is “the pacemaker of technological progress”. This is because, he said, “New products and processes do not appear full-grown [but] are founded on new principles and new conceptions which are painstakingly developed by research in the purest realms of science.” Seven decades later, U.S. federal government support for academic research has reached US \$33 billion in 2015¹⁶. In Canada, the comparable figure—delivered through the federal research granting councils¹⁷ and certain federal departments—was approximately \$3.2 billion in 2015. Further direct support, but on a much smaller scale, is provided by provincial governments, business, and non-profit organizations.

We might still ask why, precisely, should government invest in fundamental, curiosity-driven research of the type carried out in universities? The rationale advanced by Vannevar Bush in 1945 implicitly presumes a fairly direct linear chain of causation from a theoretical insight—like the possibility of harnessing electromagnetic waves to transmit information at the speed of light—to some practical device, and then to products like the telephone, radio and TV that create vast new markets, jobs and prosperity. History is filled with such examples. They underlie most of what we mean by progress. But the actual process by which research is ultimately translated into commercial innovation is far more complex and uncertain than the simple linear description suggests.

University research as global intellectual “common property”

Most academic research is published in the open literature, which means that it is available to be exploited anywhere and not just in the jurisdiction that provides funding.¹⁸ This “common property” aspect of university research is why such research is usually funded at the national level rather than by sub-jurisdictions. It is also why businesses cannot be counted on to support much fundamental research because it is hard for a company to capture the benefit when the research findings are widely available. Even most nations are too small to have much confidence that the academic research they fund will be commercialized within their own borders. On the

¹⁵ *Science-The Endless Frontier*; July 25, 1945.

¹⁶ AAAS (2016). Trends in Basic Research by Agency, 1976-2016.

¹⁷ The granting councils are the Natural Sciences and Engineering Research Council (NSERC), Canadian Institutes for Health Research (CIHR), and Social Sciences and Humanities Research Council (SSHRC). In fiscal 2014-15, funding for the councils totaled \$2.76 B (39% to NSERC, 36% to CIHR, 25% to SSHRC). Total federal funding of HERD in 2015 was \$3.17 B.

¹⁸ Academic research that is directly sponsored by business may include a requirement to delay publication; and researchers in more applied subjects often collaborate with businesses, effectively as consultants, on development projects that are not published. While important, this type of university R&D is in the minority overall.

other hand, a country as large as the U.S., with its vast depth of companies that perform research and development, is far more likely than Canada to be able to capture, for direct commercial benefit, research performed within its universities.

This begs the question as to why the tax-payers of a relatively small jurisdiction like Canada, much less Nova Scotia, should support academic research. Why not simply be a free-rider and leave it to the biggest players like the US, Japan, Germany and China; and then exploit the results? This is a fair question. The basic answer is that you simply cannot exploit most of the applications that result from leading-edge research without considerable education and training related to the area of research. That is why modern economies are so reliant on highly-qualified people. There will also always be direct local economic benefit from research that is motivated by opportunities and challenges that are specific to the place where the research is conducted, and from researchers who are engaged locally as advisers and consultants. More research of this type should be encouraged: with specific funding from government and business, and with appropriate recognition by universities themselves of the value of such research and consultancy. While the direct local benefits of research carried out in Nova Scotia's universities and NSCC are important, and need to be more widely acknowledged, *the largest benefit from government support of academic research comes from the essential role played by such research in training highly qualified people.* This may not be obvious so some explanation is in order.

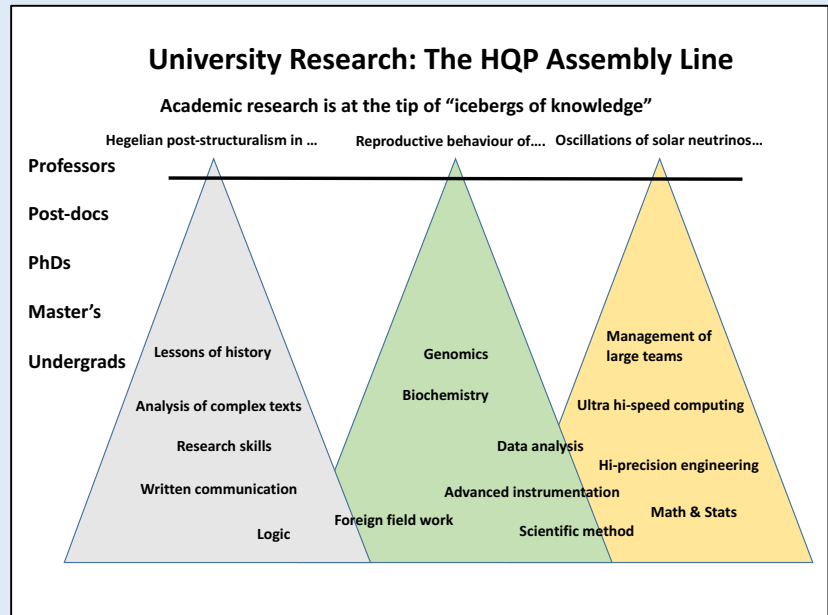
University research and the "HQP assembly line"

Most academic research is conducted to advance the frontiers of knowledge of nature, of human behaviour and culture, of the fundamental mechanisms of disease, of social processes, and so forth. Many of the topics studied at this level will strike the non-expert as esoteric, if not bizarre. For example, Dr. Arthur McDonald, a native of Sydney and a graduate in physics from Dalhousie, was awarded the Nobel Prize in 2015 for work, conducted deep underground, on the detection of "oscillations of solar neutrinos" which are among the strangest objects in the universe. What possible economic value could come from such work? We don't know yet, and perhaps not much ever will; at least not directly. But the students who work with research professors—whether in science, medicine, the arts and humanities, and other fundamental subjects—have to master very extensive bodies of *existing* knowledge to be able to function at the frontier. Research at the frontier is like the tip of an "iceberg" composed mostly of existing knowledge that students must learn (Box 2B). That knowledge is already of great practical usefulness—for example and depending on the field: knowledge of biochemistry, of genetics, of mathematics and data analysis, of animal behaviour, of economics and other social processes; of human cultures, as well as the acquisition of specialized skills in laboratory work, in the analysis of complex texts, in project management, in the design and operation of advanced equipment, and so forth. But without the esoteric work being carried out at "the tip of the iceberg" the whole process stagnates and ultimately, progress halts.

2B

The HQP Assembly Line

Much of the university research that is publicly-funded (primarily by the federal government) is highly specialized and will seem to outside observers as esoteric and often of no apparent practical value. But the fact is that the ultimate value of fundamental research at the boundary of human understanding can rarely be foreseen, so society must make provision for research that is motivated purely by curiosity and inspired intuition. We have to place some bets. The practical application may occur only many years in the future, or sometimes not at all, since research is never a sure thing. And many of the



commercial applications will take place far from where the fundamental research was conducted. But the research is nevertheless of immediate and very practical value because of the educational and training environment in which it takes place. In the highly schematic diagram above, the “esoteric” research that is undertaken in universities is in fact like the tip of an “iceberg of knowledge”, the vast majority of which was once esoteric itself. But it has now become established (under the surface, as it were), and of great practical use to doctors, lawyers, engineers, teachers, social workers, scientists, technicians — the knowledge workers in every modern economy. In order to earn advanced degrees at the Master’s and Doctoral level, students need to acquire the relevant knowledge and skills that underlie the “tip of the iceberg.” This is what is meant by the highly-qualified person (“HQP”). The knowledge and skills acquired by the student researchers on their way to today’s “esoteric” frontier of knowledge provide the foundation for “practical” applications throughout the career of an HQP.

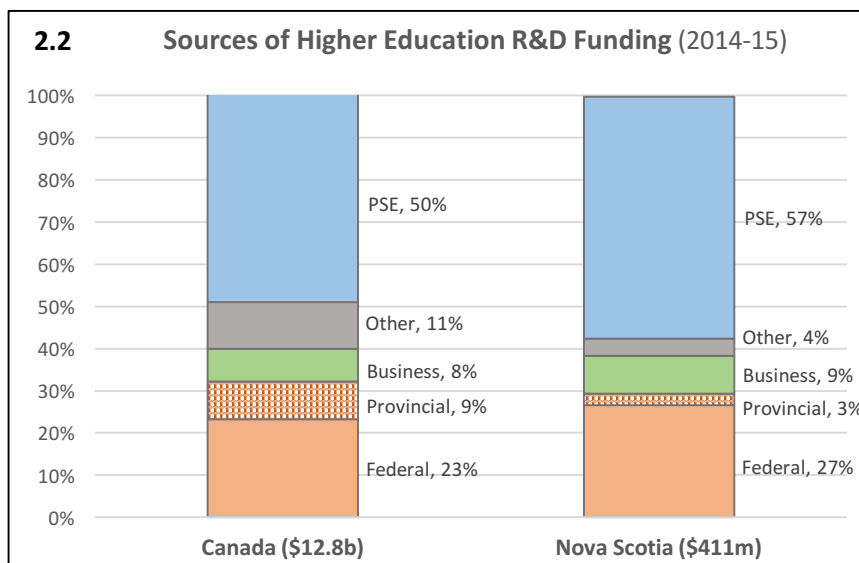
Students at the master’s, doctoral, and even advanced undergraduate levels are, in effect, apprenticed to senior scholars and learn the craft of their field of research. While some go on to be career academic researchers, many are employed in business, non-profits and the public sector. They carry into their careers the skills of “knowledge workers” and the ability to absorb and apply the leading-edge ideas, techniques and technologies being generated around the world. They are the agents by which innovation spreads out from the knowledge frontier and is adapted to the particular requirements of the business and public sectors right here in Nova Scotia. The key point to be understood is that without financial support for fundamental research, this essential process of human capital formation breaks down. The economy falls farther and farther behind. The most talented people leave for better prospects.

In Summary: The value of Provincial support for post-secondary research

The benefit to Nova Scotia of government supported research in post-secondary institutions is to:

- Produce the highly qualified people needed to drive an innovative and productive Nova Scotia economy that is increasingly dependent on the application of leading-edge knowledge and technique;
- Attract to Nova Scotia investment by companies and individuals that are the most innovative and rely, therefore, on a local supply of highly qualified graduates and on access to pools of expertise and research infrastructure resident in the province’s post-secondary institutions;
- Generate knowledge and application targeted to specific opportunities and challenges that are priorities for Nova Scotia, but are not adequately funded by the federal government or other sources;
- Enable Nova Scotia-based researchers to participate in national funding competitions through commitment of Provincial matching contributions that leverage federal and other amounts;
- Increase Nova Scotia’s rate of innovative business formation, whether by research faculty or, more frequently, by their highly trained students. (Although most academic research is reported in the open literature, there is always a first-mover advantage for locations where the work is being done.);
- Contribute a fair share to the global quest for new knowledge and thus be invited to participate in the global research networks that are at the leading edge in their fields; and
- For all of the above reasons, to enhance the reputation and global image of Nova Scotia as a knowledge-generation hotbed where exciting opportunities are being created.

Reforming Provincial Support of Post-secondary Research in Nova Scotia



The federal government is the principal external funder in Canada of higher education research and development (“HERD”), contributing about half of the support that is not provided by PSEs themselves. Provincial governments contributed about 17.6% of external support in 2014-15 (Fig. 2.2).

The federal share of *external* HERD funding in Nova Scotia, about 62%, was well above the national average, while the provincial government’s share of 6.5% was next to lowest among the 10 provinces. This has been a persistent pattern and suggests that the government of Nova Scotia is investing too little in one of the province’s significant strengths. There is a missed opportunity to employ post-secondary research proactively in support of provincial priorities.

Assuring Provincial Support for Winners of National Research Funding Competitions

Federal research funding competitions provide essential resources to maintain the research quality of Nova Scotia’s post-secondary institutions. The trend today is to allocate an increasing share of federal support to collective initiatives that are selected through national competitions—for example; Canada Foundation for Innovation (CFI) awards to purchase major research equipment; Networks of Centres of Excellence (NCEs) and Business-Led NCEs (BL-NCEs) that collaborate to tackle challenges of national significance in fields such as health care, the environment, and social systems; Centres of Excellence for Commercialization and Research (CECRs) that focus on translating university research into commercial opportunities; Canada First Research Excellence Funds (CFREFs) that provide very large multi-year funding to scale-up research capacity to an internationally-competitive level in selected fields and institutions. For example, Dalhousie led a consortium of Atlantic universities that was recently awarded, in a tough national competition, \$94 million by the federal government to create the Ocean Frontier Institute, described in Chapter 5. The list of major federal competitive awards keeps growing.

Among these, the CFI awards require that the provincial government match the amount of the federal contribution—40% of the value of the award from each of Canada and the Province with 20% from various sources. Other competitive programs may not require an explicit provincial match, at least not yet, but the presence and the amount of any Provincial support can be an important, and even decisive, consideration when selecting the winners. It is therefore essential that the Government of Nova Scotia provide the required matching funds whenever Nova Scotia institutions win awards in national research competitions. The reasons are almost self-evident:

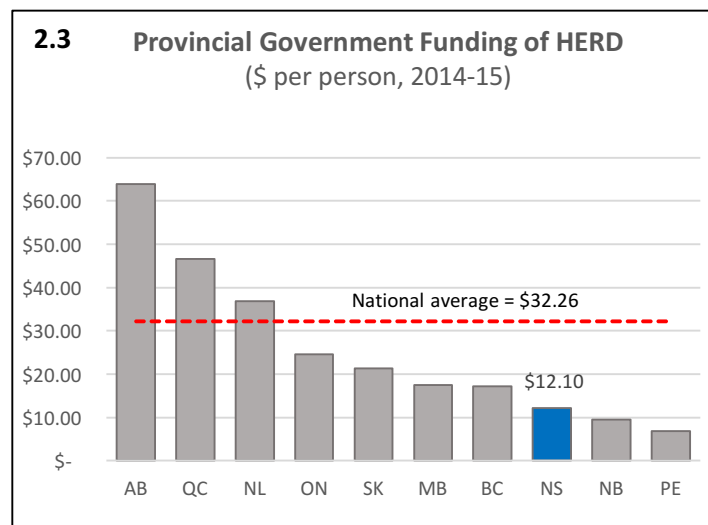
- The merit of the winning projects cannot be in doubt since the competition is with the best in Canada.
- National competitive awards enhance both the capacity and reputation of Nova Scotia as a place where world-class research is taking place. This attracts top-flight people and puts the province on the radar screens of R&D-intensive companies looking to locate near talent and excellent research facilities. (This process is self-reinforcing for the simple reason that the talent attracted by success breeds more success.)
- Provincial contributions occur in the context of external funding from Ottawa and non-provincial government sources. New funds flow into the provincial economy in some multiple of the government’s “investment”. For example, in the case of the CFI matching requirement, the Province’s 40% contribution levers 60% from other sources, a multiplier of

1.5 times. More generally, recall that in 2014, the federal government contributed \$109 million to university research in Nova Scotia, or almost 10 times the amount from the Province.

Requirements for Provincial matching going forward can only be roughly estimated since the national competitions do not follow a uniform and predictable schedule. In the most recent provincial budget, the allocation to the Nova Scotia Research & Innovation Trust (NSRIT), which provides CFI matching funds, was reduced to \$2.5 million, only about half the average allocation in past years. This will not be sufficient going forward to match the federal CFI funds that Nova Scotia post-secondary institutions are virtually certain to be awarded. Because the precise amount and timing of future awards are unpredictable, the Provincial contribution should be restored to \$5 million per year and be permitted to be carried forward year-to-year, subject to a cap.

Consolidating and Expanding Provincial Support of Post-Secondary Research

The Government of Nova Scotia lags behind all Provinces other than PEI and New Brunswick in its per capita support of post-secondary research (Fig. 2.3). For reasons already outlined: this short-changes a significant provincial strength; fails to maximize potential funding from the federal government; and misses opportunities to help Nova Scotia's economy become more innovative and competitive by attracting and retaining talent and investment.



It is evident that the Province needs to focus greater attention and resources on the support of post-secondary research. Presently, that support is fragmented and completely uncoordinated. It is being delivered principally by three organizations: (i) Nova Scotia Research & Innovation Trust (NSRIT), a passive entity with a single employee; (ii) Nova Scotia Health Research Foundation (NSHRF) a proactive organization with an independent board and some external funding; and (iii) Offshore Energy

Research Association (OERA), a specialized quasi-independent body that funds applied research relevant to offshore energy that is carried out by academic researchers and international energy consultants (Fig. 2.4).

2.4

Nova Scotia's Existing Research Funding Organizations

	Mission	Year Established	Activities	Expenditure * (2015)	Revenue Sources * (2015)	Approximate Number of Employees
Nova Scotia Research and Innovation Trust	NSRIT supports research infrastructure in Nova Scotia by matching federal funding from the Canada Foundation for Innovation.	2001	<ul style="list-style-type: none"> • Matching CFI Funding to Nova Scotia PSEs 	Program & Funding: \$2.40M Other: \$0.18M	NS Government	1
Nova Scotia Health Research Foundation	NSHRF assists, collaborates with, and funds individuals and organizations conducting health research in Nova Scotia	2000	<ul style="list-style-type: none"> • Research Funding • Grant Matching • Evaluation • Consultation • Grant Management System 	Program & Funding: \$3.78M Other: \$1.10	NS Government (82%), Investment Income (12%), Other (6%)	14
Offshore Energy Research Association of Nova Scotia	OERA leads energy research initiatives, enabling the sustainable development of Nova Scotia's offshore energy resources through strategic partnerships with academia, government and industry	2012 (Merged OEER& OETR)	<ul style="list-style-type: none"> • Research Funding • Conferences and Workshops • Student Research Travel Funding 	Program & Funding: \$2.33M Other: \$0.49M	NS Government (93%), Seminars & Forums (5%), Interest Income (2%)	7

* Total expenditure by the three organizations was \$10.3 million in 2015, 90% of which was funded by the Provincial government.

For a small province, this fragmented approach does not maximize the efficient or strategic use of scarce resources. Therefore NSRIT, NSHRF, and probably OERA, should be combined into a single organization to deliver the Province's support of post-secondary research, perhaps along the lines of Research Manitoba which was created for a similar purpose in 2014 (Box 2C).

Consolidation under one roof—"Research Nova Scotia" (RNS)—would:

- Create a vehicle to identify and advance Nova Scotia's research priorities which inevitably cut across the various academic disciplines.
- Facilitate the *strategic* allocation of research funding: (a) to support Provincial priorities; and (b) to optimize Provincial support for NS-based proposals in national research funding competitions. (When the Province's post-secondary research support resides in separate organizations structured along disciplinary lines, as is now the case, it is difficult to address multi-disciplinary initiatives and to re-allocate funds across separate organizational boundaries.)
- Create the scale and focused mandate to increase Nova Scotia's "voice" with federal research funders; in inter-provincial dialogs on research funding; and within the government of Nova Scotia itself.

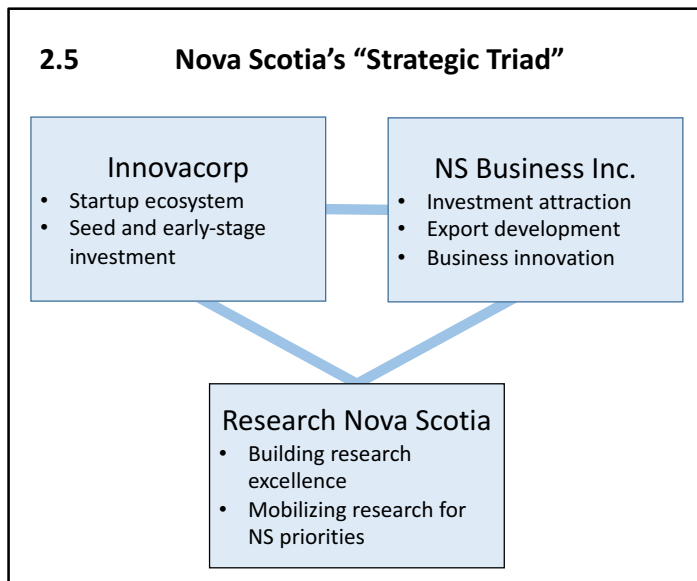
2C

Research Manitoba

Research Manitoba is that Province’s central agency for all Provincially-supported research in health, natural and social sciences, engineering, and the humanities. Reporting to the Minister of Jobs and the Economy, it was established in 2014 to bring major Provincial research funding structures under one umbrella. Funding is based on a competitive peer-reviewed process assisted with software developed jointly with the Nova Scotia Health Research Foundation. In 2014, Research Manitoba allocated \$19.8M to research projects. Consolidating research services into a single organization with an increased budget boosted the funding pool for research projects in the province, increasing the potential for larger research initiatives to be supported. Having a centralized research authority improves Manitoba’s ability to better align research funding with provincial priorities. In addition to creating a ‘one stop shop’ for research support, the new central organization has fostered greater interdisciplinary research collaboration. Research Manitoba has also strengthened the province’s capacity to leverage additional research funding by making it easier to identify high-potential projects across all disciplines.

Nova Scotia’s “Strategic Triad”

Research Nova Scotia would not simply be a funding vehicle. Its primary mission would be strategic. It would be Nova Scotia’s agent by which to mobilize the province’s post-secondary research advantage to contribute to a more innovative and prosperous society. The role of RNS in respect of Provincial engagement with research would be analogous in many ways to that of Innovacorp in the context of innovative startups, and of NSBI in the context of investment attraction, SME business innovation and export growth. The three organizations would give the Province a *strategic triad* to anchor a coherent innovative growth strategy. To affirm the three-fold symmetry of roles, RNS should be structured as a crown corporation (Fig. 2.5).



Funding of RNS should be increased over time, at least to the national *per capita* average of provincial government support for post-secondary research, which in 2014 was \$32 nationally compared with Nova Scotia’s \$12. Meanwhile, the strategic role of RNS needs to be enabled at the outset with a moderate amount of new money—on the order of \$5 million *per year*.

A “Research Opportunities Fund”

The additional resources should be used to establish a “Nova Scotia Research

Opportunities Fund” that would support targeted research-based initiatives in areas of particular importance to Nova Scotia. This might, for example, be an opportunity to make a proposal (in an area of provincial priority) to a major federal research funding competition; or to attract a

significant business R&D project to a company located here; or to undertake collaborative research with a federal department. The opportunities would be identified based on criteria such as alignment with one or more provincial priorities; the excellence of the research component; the contribution to the development of highly qualified people; the prospect of significant leverage of the Fund’s resources with other sources of funding. The most promising opportunities could be identified—and periodically re-evaluated based on experience and new information—by a small advisory board to RNS with representation from research-intensive universities (including Dalhousie as a standing member); the federal research establishment in Nova Scotia; one or more business R&D performers. The advisory board would *not* allocate grants from the Research Opportunities Fund but rather would identify the best opportunities to be pursued which, if successful, would qualify for a committed amount of Research Opportunity Funding agreed to by RNS.

In short, Nova Scotia needs to have an independent capability to leverage its post-secondary research advantage to complement, and go beyond, support from the national level. This capability, supported by the Research Opportunities Fund, would not only bring leading-edge knowledge to bear on opportunities and challenges that are of particular importance to Nova Scotia, but would also produce the highly-qualified talent to address them in practical terms.

2.1 Recommendation on the Creation and Role of “Research Nova Scotia”

- Consolidate and broaden the Province’s post-secondary research granting functions—presently conducted primarily through NSRIT, NSHRF and OERA—in a single organization, “Research Nova Scotia” (RNS). The consolidated organization, which should be structured as a crown corporation, would:
 - a) Focus Provincial research funding on areas of greatest strategic importance for Nova Scotia. (The Province should consult with the full range of research institutions and with researchers themselves to encourage proposals that are particularly relevant to achieving a more innovative Nova Scotia economy.)
 - b) Build upon the strengths of its predecessor organizations (particularly NSHRF and OERA) ensuring that their mandates, experience, and established relationships are well-integrated in RNS.
 - c) Allocate sufficient Provincial funds to maximize funding and benefits from non-provincial (primarily federal) sources through competitive research funding programs such as CFI, Centres of Excellence in Commercialization and Research, Genome Canada, and others.
 - d) Build up the global research excellence of Dalhousie and the excellence in particular fields within other Nova Scotia post-secondary institutions.
 - e) Strengthen research collaboration among Nova Scotia’s post-secondary institutions themselves, with others in Canada and abroad, and with business and civil society.

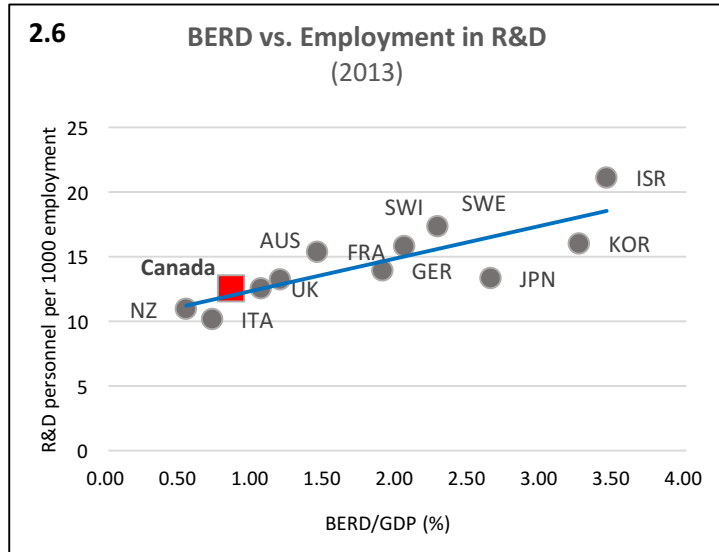
- The Province should make available regular funding to Research Nova Scotia that is sufficient to provide required provincial matching amounts for Nova Scotia winners in federal research granting competitions. In view of the unpredictable matching requirements from year to year, the annual grant for this purpose should be placed in a trust and allowed to accumulate, up to some specified cap.
- Provide Research Nova Scotia with annual funding to cover the Provincial matching requirement for the growing “Mitacs” business research internship program.
- Create, within Research Nova Scotia, a new “Research Opportunities Fund” that would support targeted research-based initiatives in areas of particular importance to Nova Scotia. The opportunities could involve, for example, federal research funding competitions or collaborative R&D projects with business partners. Opportunities should be identified according to criteria that include alignment with provincial priorities, research excellence, training of students, and significant leverage of Research Opportunity Funds. The Province should provide RNS with \$5 million per year, for an initial 5-year pilot period, exclusively to support the Fund.
- The Province should increase, over time, its level of post-secondary research support to the national *per capita* average. In 2017-18, funding of Research Nova Scotia (which will include amounts budgeted under the predecessor organizations) should be sufficient to meet the anticipated amount required in that year to fulfill the mandate elements outlined above.

Translating Post-Secondary Research into Commercial Opportunity

The commercial exploitation of research and development (R&D) is the responsibility of business, but the earlier stages can often benefit from collaboration with universities — for example, through access to the academic sector’s well-equipped labs and breadth of faculty and student skills. Beyond these benefits, and as outlined earlier, post-secondary research is the ultimate enabler of commercial R&D through the essential role such research plays in the development of highly qualified people. The students who are trained at the leading edge of knowledge in university research projects go on in their careers to be the ones that actually carry out R&D in commercial settings. That is why there is a tight correlation between business expenditure on R&D (“BERD”) and employment rates of scientists and technologists (Fig. 2.6).

Unfortunately, business expenditure on R&D in Nova Scotia, and in Atlantic Canada, is the lowest in relative terms in Canada, while Canada is among the lowest business R&D spenders, in relative terms, in the OECD group of highly-developed countries. This long-standing situation has resisted policy remedies but is ultimately untenable if Canada’s trade-exposed businesses

hope to remain competitive¹⁹. In the end, it will be the irresistible pressure coming from the global marketplace that will force Canadian, and certainly Nova Scotian companies to become more innovative and, in many cases, to give much greater priority to R&D and collaboration with university-based researchers.



Many companies in Nova Scotia are already showing the way but there are still far too few (Box 2D). Until more businesses embrace innovation, Nova Scotia will not be able to fully capture the return on its investment in post-secondary research. That is because universities are turning out more highly qualified graduates than the province's low-innovation economy can productively employ. Too many leave for more attractive opportunities taking with them the human capital produced in Nova Scotia.

The answer certainly is *not* to cut back on investment in Nova Scotia's post-secondary research advantage. That could only lead backward and make Nova Scotia less attractive to the businesses of the future and to the entrepreneurial talent needed to develop those businesses. The answer instead is to *complement* the growing pressure to innovate that is already coming from global markets. This can be done with new initiatives to strongly encourage Nova Scotia businesses to take much greater advantage of the leading-edge knowledge and highly qualified graduates being produced by the province's universities and colleges. Taking full advantage of the Mitacs program (described later in the chapter) is one obvious example. Another would be to provide multi-year wage support to selected export-oriented SMEs that hire advanced graduates. Yet another would be to increase the maximum amount of the Province's Innovation and Productivity Voucher and employ the voucher tool to encourage innovation-oriented companies to invest and locate in Nova Scotia (see chapter 4). In fact, a central element of the mandates of Nova Scotia's triad of Innovacorp, NSBI, and RNS should be to implement deeply collaborative strategies to increase the uptake by businesses of the research and highly-trained people coming out of the province's post-secondary system. This will exploit what is already one of Nova Scotia's real strengths; will increase the return on public investment in research; and, most important, will equip the province's businesses to compete and prosper in the economy of the future.

¹⁹ Trade-exposed businesses, which constitute a large share of Canada's economy, are those that are directly involved in exporting and/or importing or, even if domestically focused, face competition from imports. Such businesses must remain internationally competitive to grow, or even to survive.

2D**Commercializing University Research: Three Examples****Jeff Dahn and Tesla**

Jeff Dahn is a world-leading researcher on rechargeable batteries. Professor Dahn's battery technology research team at Dalhousie recently concluded a project with 3M Canada through NSERC's Industrial Research Chairs program. In June of 2016, Dahn began an exclusive 5-year research partnership with Tesla Motors, the innovative electric car company. This marks the first time the California-based company has collaborated with a university anywhere in the world. Dahn's team will work with Tesla to increase both the energy density and lifetime of lithium-ion battery cells. This project, which is a continuation of work Dahn has been conducting since 1996 on increasing energy density and lifetime, promises to have applications in a variety of automotive and grid energy storage applications.

QRA

Big companies often identify design errors in complicated control systems only *after* they have built prototypes at great time and expense. QRA solves this dilemma with software that analyzes and detects problems to permit their early correction. QRA was founded in Halifax in 2013 and grew out of work that Dr. Jordan Kyriakidis performed on a research contract at Dalhousie. QRA already has two products on the market--QVscribe analyzes requirements documents for inconsistencies, ambiguities, and other errors, while QVtrace analyzes model-based designs. The intellectual property is wholly owned by QRA. Although the company's software is industry-agnostic, value is provided by integration tailored to the needs of clients, the largest of which is US-based Lockheed Martin Aeronautics. QRA also deals with naval and automotive clients. The company has received \$3 million of assistance from government sources, including large contributions from ACOA, NSBI, and IRAP. QRA received a \$1 million investment from Innovacorp in 2014 and enjoys the support of several foreign investors. The company employs seventeen people, and is an impressive example of a fast-growing, research-based enterprise that has succeeded in bringing highly innovative products to market.

ABK Biomedical

Halifax-based ABK Biomedical was established in 2010 to commercially develop innovative materials that can be used in "embolic therapies" to treat cancer. These therapies use tiny beads to block the flow of blood to a tumor or abnormal tissue. ABK has developed beads whose position can be visualized and determined very accurately with X-rays thereby permitting clinicians to more accurately target treatment that is both more effective and with fewer complications. The company has several products that grew out of research conducted by Dr. Daniel Boyd at Dalhousie University, and are currently moving through the regulatory process in Canada, the US and the EU *en route* to market launch anticipated in 2017. ABK has ten full-time employees at its lab facilities in Innovacorp's life sciences incubator on the Dalhousie campus. ABK is an exciting example of the commercialization of the cutting-edge academic research being carried out in Nova Scotia universities. The ABK story also demonstrates the importance of "patient" seed and early-stage financing and of incubation facilities in bridging the wide gap between research findings and their commercial implementation.

Collaborations between business and PSEs are certainly a key, but under-exploited feature of this process. Closer linkages are therefore needed between academic research and business application, mediated through entrepreneurial professors and their students working on intensely practical problems with companies throughout the province and in all sectors. There are many examples of such fruitful collaborations, often involving smaller universities or NSCC (Box 2E).

In general, however, the relationship between business and academic research has proven to be a challenge virtually everywhere because universities and businesses are shaped by very different objectives and with correspondingly different reward systems and cultures²⁰.

There is a spectrum of organizations working hard to bridge the divide, including the technology transfer offices at the PSEs, with the support of Springboard Atlantic. PSEs also support commercialization programs through their entrepreneurship and sandbox programs for students, and through support for researchers who are seeking to translate their specialized knowledge and/or research into new businesses. Innovacorp's very successful Early Stage Commercialization Fund plays a particularly effective critical role by providing up to \$50,000 for researchers to help commercialize their work, including assessing market potential, developing go-to-market strategies, finishing proof-of-concept development, building prototypes, and leveraging other funds.

As one concrete and promising new initiative to bridge the divide, Dalhousie is establishing an Atlantic Canadian node, and the first in the country, of the U.S. National Science Foundation's highly successful Innovation Corps (I-Corps) program. The program, which is offered by U.S. universities and funded by the NSF, aims to foster entrepreneurship that will lead to the commercialization, typically through startups, of technology that has been supported previously by NSF-funded research. I-Corps prepares scientists and engineers to extend their focus beyond the laboratory to generate impact in society or in the commercial world. The innovative program combines experience and guidance from established entrepreneurs in the context of a targeted curriculum. The natural sponsor for an "Innovation Corps Canada" ("I-Corps Canada") would be NSERC, the federal science and engineering granting council. The Atlantic Growth Strategy might include a pilot of an "I-Corps Atlantic" delivered through a collaboration between (i) NSERC and ACOA to design and fund the pilot initiative, and (ii) research-oriented post-secondary institutions in Atlantic Canada to identify mentors and deliver the relevant curriculum.

Nova Scotia is fortunate to have a network of universities and NSCC campuses that span the province such that most of the population is within about 50 km of a PSE presence. In order to fully realize the benefits of research, universities and the campuses of NSCC need to play a greater role as regional hubs for innovation and problem-solving by helping to mobilize knowledge in communities and to advise in respect of social and business development in their surrounding areas. Some institutions in the province have already established a strong commitment in that regard, so there is already a great deal of experience to be shared. At the same time, the academic research community collectively, and tenure/promotion bodies in

²⁰ Norman Augustine, the former CEO of the US defence giant, Lockheed-Martin, said that while his company spent a lot of time on university campuses it was not to collaborate with research professors, but rather to identify the most talented students. He observed that the cultures of the academy and of business were just too different and quipped: "In the university, it's publish OR perish, but in my business it's publish AND perish." (Private conversation with Peter Nicholson)

particular, have to give greater weight to service in fulfillment of the “Third Mission” of the post-secondary system which, beyond education and research, is to serve the larger community.

2E**NSCC: An Applied Research Asset for Nova Scotia**

The Nova Scotia Community College (NSCC) has built up an impressive capacity for applied R&D of great benefit to business and communities throughout the province. The NSCC has expertise in geomatics, aerospace, information and communications technology, mechanical, electrical and electronic technology, robotics, medical devices, the built environment, alternative energy, energy conservation, horticulture, and ocean technology. Just a few of the many examples of NSCC’s research and its impact on business include:

- An industrial research chair for colleges in Integrated Ocean Mapping Technologies, held by Dr. Craig Brown, which has benefitted the fishing industry by using acoustics, sensors, video and data analytics to develop predictive models enabling significantly more efficient and sustainable harvesting strategies for shellfish species in the offshore region of Nova Scotia.
- Working with an NSCC team led by research scientist Dr. Tim Webster and utilizing high-tech equipment acquired through CFI, Acadian Seaplants has been enabled to use satellite imagery and high-performance software to identify the location and quantity of harvestable seaweed at a much higher rate than had been possible.
- Drones with infrared sensors are being used by NSCC’s Applied Geomatics Research Group to acquire data which will help with decision-making to enhance crop yield and improve efficiencies.
- NSCC, Dalhousie and Memorial, together with an industry partner collaborated on the development and testing of tidal turbine models. Dalhousie developed the engineering drawings, constructed a 3D model and completed a basic analysis; NSCC produced a larger scale prototype of the turbine for testing using a metal 3D printer; and the turbines were shipped to Memorial for testing in a state-of-the-art 54 meter towing tank. This is an outstanding example of collaboration among Atlantic Canadian PSEs.
- A team of NSCC students and faculty designed, developed and collaborated on the installation of a solar energy solution that mitigates the effects of rolling black-outs and cut the cost of backup diesel generators at a vocational training centre in Tanzania. The NSCC team was awarded the 2015 Panorama Award for Outstanding International Education Program from the Canadian Bureau for Education.

2.2 Recommendation on Research Collaboration Between Business and Post-Secondary Institutions

- Establish within the mandates of the “strategic triad” of Research Nova Scotia, Innovacorp, and NSBI a requirement for mutual collaboration to develop strategies that will increase engagement of PSE researchers with business to work on challenges that are likely to have high economic impact, either in the short or longer term.
- Build on the existing Productivity and Innovation Voucher program by increasing the upper limit per application, which is currently \$25,000. Use the vouchers (which can be redeemed to purchase R&D services from post-secondary institutions) to encourage innovative companies to locate and invest in Nova Scotia.
- In the context of the Atlantic Growth Strategy, NSERC and ACOA should fund an “I-Corps Atlantic”, building on LaunchDal’s I-Corps initiative to include nodes in each of the Atlantic Provinces.

Maximizing the Mitacs opportunity

Government support through internship and wage subsidies can help to develop an internship culture within a business or other organization while mitigating some of the financial risk. The national “Mitacs” program has a proven track record in this regard and merits expansion and increased provincial support. More generally, it is hoped that a growing number of employers will recognize the benefit that interns can bring, leading ultimately to a stronger culture of work-integrated learning and decreased dependence on government support. In complementary fashion, all post-secondary degree programs should eventually include a work-integrated learning opportunity, if not always as a strict requirement (Box 2F.)

In its *Collaborative Action Plan*, the ONE Nova Scotia Coalition recommended that the Province maximize its participation in Mitacs’ flagship “Accelerate Innovation” program, notably to support the important goal of retaining more new graduates and highly qualified people in the province. *Accelerate* creates and supports collaborative research projects involving industry, graduate students and postdocs, and researchers. It provides opportunities for researchers to apply their specialized knowledge to solve key industry and community challenges. In doing so, interns gain applied experience that is increasingly essential for career success in today’s knowledge-intensive economy.

There is a potentially powerful synergy between the research internship funding provided through Mitacs and the advanced training that is being facilitated by the Province’s Graduate Scholarship program for top-notch students in Master’s and Doctoral programs in fields that are aligned with designated provincial priorities (e.g., oceans S&T, ICT, cleantech, life sciences). Taken together, the two programs create a pathway for talented individuals to proceed through advanced training into the practical experience that can put their research-honed skills to early use. The value that the Mitacs *Accelerate* program brings to Nova Scotia is therefore doubly significant but to gain the full benefit the government will have to be prepared to increase its investment.

Over the next four years, Mitacs expects to double its annual number of internships to 10,000 across Canada. The expansion of the *Accelerate* program will be supported in part by federal funding, which increases Nova Scotia’s expected *pro rata* share of the program. If Nova Scotia remains committed to this initiative, it is currently estimated that to maintain its proportional share and meet projected demand, the Province will eventually need to increase Mitacs funding, via Research Nova Scotia, to approximately \$1 million by 2019-20 from \$265 thousand this fiscal year.

2F**Mitacs**

“Mitacs” is recognized as the leading program in Canada for matching talented interns and employers for research-oriented positions. Mitacs interns are effectively vectors of innovation bringing up-to-date research knowledge and skills to their host company. Nova Scotia’s contribution to support a Mitacs intern comes with high leverage. By covering roughly 25% of the cost, the Province attracts on average a further 35% via federal support of Mitacs, with the remaining 40% provided by the employer. Almost 50% of companies hire their Mitacs interns on a full-time basis, with about 20% creating new positions. Approximately 15% of Mitacs interns start their own businesses.

In the first six months of fiscal year 2016-17, Mitacs has used Nova Scotia’s \$265,000 investment to leverage a program valued at over \$1.17 million in support of 67 Accelerate internships. Mitacs is currently unable to meet demand for the program from Nova Scotia companies and graduate students, as there are 87 internship units already submitted (as of September, 2016), with six months remaining in the fiscal year. Recently, the Province has not been fully contributing its expected share to support qualified Mitacs interns. The shortfall has been covered by Mitacs in 2016, but has limited the program’s capacity to expand in Nova Scotia.

2.3 Recommendation on Provincial Funding of Mitacs Interns

Provincial funding for Mitacs research internships with business should be increased to match the growth in demand to ensure that there is no business willing to hire a Mitacs intern that does not receive program funding.

Chapter 3 NOURISHING THE STARTUP ECOSYSTEM

“So throw off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover.” — Mark Twain

The Kaufmann Foundation’s Report, *The Importance of Start-ups in Job Creation and Job Destruction*, shows that for all but seven years going back to 1977, startups have been the net job creators in the United States. While U.S. firms lose an average of about a million jobs annually, new firms add an average of three million. In particular, high growth and innovative startups are the so-called "gazelles" of the economy—companies with at least \$100,000 in sales, that grow 20% or more annually for four years and double revenue in the process. Gazelles account for less than 5% of all firms but for 60% of net new jobs. Of the remaining 40 percent, about half came from other startups, and half from large companies. These results have been approximately replicated worldwide. The most important message of the Kaufmann research is that supporting excellence and innovation in the economy benefits far more than just a small group of winners. On the contrary, the job creation record of growth firms suggests that it is the best way of creating widespread prosperity and opportunity.

That is why Nova Scotia’s thriving startup community of innovative, high growth, early-stage companies needs to be nurtured so that they can become tomorrow’s dynamic job creators. Although there is a surprisingly large number of innovative startups operating in Nova Scotia today, their contribution to jobs and income is still relatively tiny. Yet like the acorns that eventually grow into oaks, these startups, operating at the cutting edge of innovation, represent the green shoots of the future economy. A small but representative sample of Nova Scotia startup vignettes is assembled in the Annex at the end of this chapter.

<p>3A</p>	<p>2015 Highlights from the Nova Scotia Startup Community (Moreira Report, 2016)</p> <ul style="list-style-type: none"> • Nova Scotia is home to almost 200 high-growth startups developing innovative technologies for export markets. This represents 54% of the Atlantic total. Similarly, 54% of the 130 gazelles are located in Nova Scotia. (Gazelles are fast growing startups with \$100,000 or more of sales and 20% growth in revenue for at least four years.) In 2015, 46 new high growth startups were formed in Nova Scotia, an increase of 28%. Nova Scotia’s startups raised approximately \$55 million in venture capital during 2015. • Startups in Nova Scotia had a 38% growth in employment and 96% growth in revenue in 2015. • Nova Scotia has benefitted mainly from two factors: (i) Halifax is the largest metropolitan area in the region, and represents 38% of all Atlantic startups, and startups tend to thrive in urban areas; (ii) the Cape Breton startup community has been adding companies rapidly over the past two years. • 60% of Nova Scotia startups are affiliated with universities (i.e. those that grew from university research or entrepreneurship programs, or those working with university researchers). These affiliated startups grew at a stronger rate than the overall community—110 percent revenue growth, which was 40% higher than peers. • Although there are more ICT startups (117) than in other sectors, the sectoral diversity is a strength in Nova Scotia, and includes Life Sciences (47), Manufacturing/Hardware (17) and Cleantech (16).
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Building Nova Scotia’s Startup Ecosystem – Incubators, Accelerators and Venture Capital

A 2014 report by Gilles Durufle for the provincial government²¹ outlines the case for government intervention to support the angel investor and venture capital (VC) industry:

- Venture capital investment has strong positive effects on innovation, wealth creation, economic growth and employment.
- The financing of technology startups is subject to “positive externalities”, meaning that the return for the whole economy may be superior to the financial return for venture capital funds. Therefore, without government support, the level of VC investment may be less than optimal for society.
- The building of a sustainable technology startup ecosystem is the result of a virtuous circle with cumulative effects—i.e. it is easier to launch the 100th startup in a given place than the 1st one. There is a proactive role for government to “start the wheel.”

The Durufle report also outlined certain pitfalls of government intervention in the markets for angel and VC financing, including the risk of ill-designed programs that are not based on how these markets work in practice; that underestimate risks; and that lack the proper implementation skills. As jurisdictions have come to better understand these pitfalls, they have designed new programs that can avoid them. There is, for example:

- a trend in the delivery of government support toward indirect and arm’s-length interventions, with the objective of supporting the development of a private sector VC industry able to attract experienced managers and implement best practices;
- less focus on geographic constraints or on requiring a specified amount of investment within a given period of time, since these constraints may have adverse effects on returns and on alignment of interests with potential private sector co-investors; and
- an increasing recognition that business angels play a critically important role in the startup ecosystem since they provide not only funding but also experience, credibility, and connections that improve the overall flow of high-quality investee firms.

Stimulating the Supply of Seed and Early Stage Venture Capital

Innovacorp, a provincial crown corporation, delivers the Province’s support for Nova Scotia’s innovative startups (Box 3C). Its Nova Scotia First Fund (NSFF) plays an essential role as a seed and early stage investor where the private sector has proven reluctant to participate: specifically in the so-called “hard sectors” like health and life sciences, bio-technology, clean technology, ocean technology agri-food, and advanced manufacturing. These are sectors where capital requirements tend to be large and time to revenue, long. To invest effectively in these domains,

²¹ Fueling Entrepreneurship & Innovation: A Review of the Nova Scotia Government’s Role in Venture Capital Provision; Gilles Durufle, June 2014. Dr. Durufle is an internationally-recognized expert on the funding of technology-based startup companies.

Innovacorp will need to continue to attract highly specialized employees and partners that possess the experience, extensive networks, and proven track record to effectively select and mentor startups.

Innovacorp has had a significant impact in fostering the nascent ICT sector in Nova Scotia which after 10 years is emerging as a more mature investment opportunity capable of attracting private sector investors even at very early stages. With Build Ventures (Box 3D) already providing private sector-managed “Series A” venture capital in Atlantic Canada, there is also now an opportunity to attract private sector managers for the seed capital stage in the ICT sector. To this end, the Province announced a new \$25 million private sector-managed seed fund (referred to in what follows as the “New Fund”). Although the New Fund is expected to be formally agnostic as to sectoral focus, in practice it will most likely invest primarily in ICT companies where the prospect of quicker returns and relatively low capital requirements stimulates greater private sector interest (Figure 3.1).

3B Selected Observations from the Duruflé Report

- “The Atlantic provinces are all confronted by the same challenge of limited resources and distance from the main technology clusters. Outside investors that are much needed do not make much of a distinction between Nova Scotia and New Brunswick [...] When facing the development of their tech ecosystem, governments should adopt as much as possible a regional approach.”
- “In order to be successful, tech companies must reach out very early on: markets, expertise and networks, recruitment of talent, sources of funding (business angels and specialized venture capital funds). Helping entrepreneurs, directly or indirectly, in this difficult task should be one of the main objectives of government support to the ecosystem.”
- “Strengthening mentorship and networks around entrepreneurs is key to the success of the ecosystem. However, in order to be successful, acceleration processes should remain very selective and demanding and run by entrepreneurial teams.”
- “Volta Labs and Propel ICT deal with ICT companies. Other sectors such as life sciences, cleantech and ocean technologies should not be neglected, for diversification reasons and because of specific strengths of the region and its universities in these domains.”
- “[...] the Nova Scotia tech business community should take a leadership role to make itself more visible and link with the universities and the resources of the broader business community.”

Source: Duruflé, G. (2014, June). *Fueling Entrepreneurship & Innovation: A Review of the Nova Scotia Government’s Role in Venture Capital Provision*.

3C**Innovacorp**

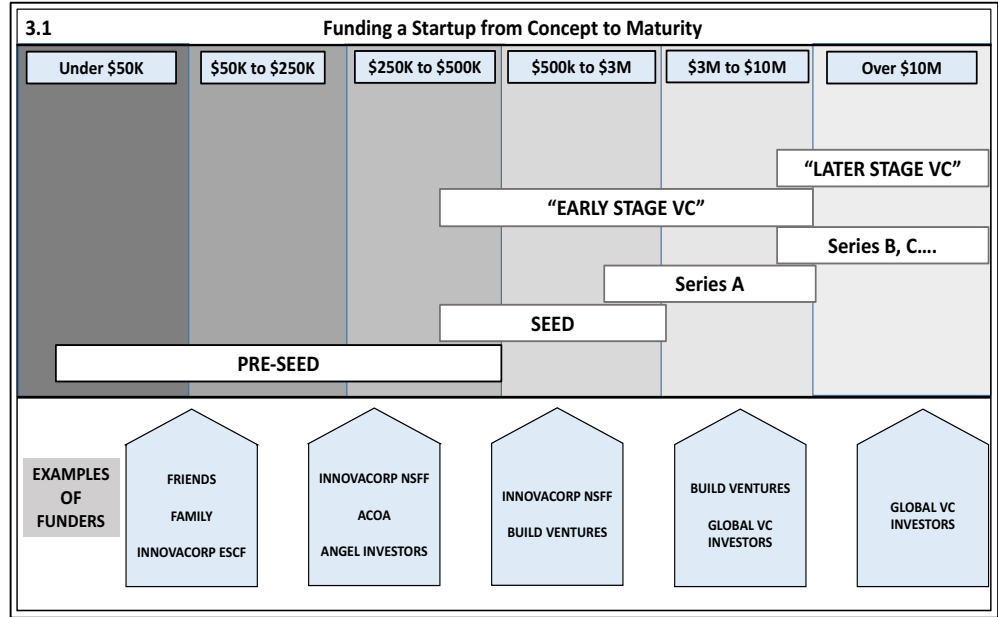
Innovacorp is a provincial crown corporation that provides risk capital, business advisory services, and incubation facilities to knowledge-intensive Nova Scotia startups. It has a private sector board of directors, but is largely funded by an annual grant from the Province. Innovacorp primarily supports companies in the information technology, clean technology, life sciences, and ocean technology sectors. Its seed and early-stage investments are usually less than \$500,000. Since 2001, Innovacorp has made 63 investments in 43 start-ups (33 still active), invested \$30 million, and leveraged \$51.3 million from other private investors/VCs, mostly from outside the region. Its active portfolio of companies have export sales of \$36 million; payrolls of \$37 million; and employment of 490 skilled jobs. It currently has 11 life science companies and 11 cleantech/smart energy companies under incubation. The corporation has partnered with other innovation-oriented organizations and has made investments in private sector funds, including Halifax-based Build Ventures. Innovacorp's principal programs are:

- *Nova Scotia First Fund* is the fourth most active government-backed venture capital fund in Canada. It targets emerging venture-grade technology companies with high growth potential and attractive risk-return prospects.
- *Early Stage Commercialization Fund* supports university and college research projects that demonstrate potential to advance a technology to a prototype or proof-of-concept stage.
- *I-3 Competition* disburses awards of up to \$100,000 to high potential Nova Scotia startups. Winners are chosen based on the quality of the product or service, industry knowledge and management experience, market size, and credibility of plans to reach key milestones.
- *Spark Cape Breton* gives mentoring and cash awards of up to \$50,000 to promising knowledge-based early stage companies based in Cape Breton.
- *Productivity and Innovation Voucher* program promotes collaboration between SMEs and academic researchers. The voucher is a credit note of up to \$25,000 for companies to access expertise and technical solutions from the province's academic institutions.
- *Incubation facilities* are managed by Innovacorp at the Enterprise Centre in Halifax, the Technology Innovation Centre in Dartmouth, and the Demonstration Centre in Brooklyn.

3D**Build Ventures — An Atlantic Venture Capital Investor**

Established in 2013, Halifax-based Build Ventures provides early-stage capital (typically “Series A” investments) to high-growth innovative firms based in Atlantic Canada. Build Ventures manages \$65 million, and invests in increments of \$1 to \$5 million. The four provincial governments and BDC together contributed about \$60 million initial capitalization, with the balance coming from private fund managers. Build Ventures holds equity in many Atlantic Canadian firms including, for example: Affinio and Springloaded Technology (based in NS), Celtx (Newfoundland), Introhive and Resson Aerospace (New Brunswick). Several of its portfolio companies have previously been supported by Innovacorp. Dr. Gilles Duruflé noted that “the Build Ventures model...is perceived by funds based outside the region as a like-minded private-sector co-investor and as a value-added investor.” Build Ventures employs public sector co-investment to grow the small pool of risk capital available in Atlantic Canada, while ensuring that funds are managed according to private sector objectives.

If the New Fund proves successful in mobilizing seed and early-stage private investment in ICT, the need for Innovacorp to target the same niche will obviously diminish. This would free up resources for Innovacorp to focus even more intensively on the hard sectors where seed and early-stage government investment is most needed. (At present, approximately half of Innovacorp’s portfolio is invested in ICT.)



Innovacorp has meanwhile positioned itself as a “for return” investor²² in order to be regarded by private investors as like-minded and therefore as an attractive co-investment partner. While this is quite appropriate, it nevertheless creates a natural tension within Innovacorp’s portfolio between the generally more attractive ICT sector and the hard sectors which tend to be shunned by private (“for return”) investors at the seed and early stages. Innovacorp’s portfolio should not be heavily weighted toward ICT in an effort to increase the average return since this could leave other sectors with too little early-stage investment while at the same time overlapping the role of the New Fund as a seed and early-stage investor in ICT.

A constraint should therefore be set on the fraction of Innovacorp’s portfolio that is invested in ICT and, depending on experience with the New Fund, the constraint could be progressively tightened over time while the fraction invested in hard sectors is increased. In these latter sectors, Innovacorp is typically the sole institutional investor and is thus not subject to as much competitive pressure as would be the case if there were many other angel, seed and early-stage investors. Innovacorp should therefore balance its “for return” focus with broader objectives and be mandated and measured according to a balanced scorecard that would, for example, evaluate success in helping an investee grow revenue, attract further private investment, scale-up internationally, and also ultimately generate a targeted rate of return on its investments.

²² Innovacorp’s legislated mandate is to grow successful tech companies and support the growth of the startup ecosystem. The legislation does not impose any mandate regarding return on investment, but the company’s Board has adopted a “for return” investment policy. This is not interpreted as necessarily “maximum return”. The objective, rather, is to return over the longer run at least: (a) the government’s investment increased by a return equal to the government’s cost of funds; plus (b) the actual cost of operating the NS First Fund.

Right now, Innovacorp’s NSFF is effectively fully subscribed (save for capital reserved for follow-on investments). It must be recapitalized without delay or the extraordinary progress being made in the Nova Scotia startup community will be put at risk because there is no other institutional investor for seed capital in the province. Building a startup community takes decades, and the province is now on the verge of hitting full stride. Any delay in recapitalizing the NSFF would stall the momentum and injure the reputation of Nova Scotia as a place where innovative startups can thrive. Further, the creation of the New Fund should not slow down recapitalization of the NSFF: it could take well over a year for the New Fund to be established and begin active investing and it will almost certainly not invest sufficiently in startups in the hard sectors, meaning that there is an urgent need for the recapitalization of the NSFF now and there will be a continuing need for the NSFF in the future.

3.1 Recommendation on Seed and Venture Capital

- The Province should issue the pending “Request for Proposals” for the new \$25 million private sector seed capital fund (“New Fund”) and ensure that its mandate includes provision of seed and early-stage private investment in ICT-sector companies in Nova Scotia. This fund could potentially become an Atlantic-wide seed fund if the federal government and other Atlantic Provinces agree as part of the Atlantic Growth Strategy.
- The Province should immediately provide \$40 million to recapitalize the Nova Scotia First Fund (NSFF) to ensure sufficient early stage capital for the startup ecosystem. Innovacorp’s mandate should focus on pre-seed, seed and “Series A” follow-on venture capital investments in complex, capital intensive sectors where private investors are reluctant to participate at the earlier stages. These “hard” sectors include health and life sciences, biotechnology, clean technology, ocean technology, agri-food, and advanced manufacturing.
- The NSFF should not allocate more than 50% of its capital to ICT-based companies. Depending on the success of the “New Fund” in providing sufficient investment for ICT startups, the Department of Business should work with the Board of Directors of Innovacorp to progressively reduce the allocation of the NSFF to the ICT sector.
- Innovacorp should continue to act as a limited partner in private sector funds that invest in ICT companies including, for example, in the “New Fund” and Build Ventures.
- Innovacorp’s performance should be measured with a balanced scorecard that evaluates its success in: (a) supporting the growth of the Nova Scotia startup ecosystem; (b) finding, funding and fostering the formation of technology-based companies; (c) attracting private co-investment; (d) helping investees grow export sales and scale internationally; and (e) achieving rate of return targets established by the Province, Innovacorp’s sole shareholder. Quantitative and qualitative measures of these objectives should be developed collaboratively by Innovacorp’s Board of Directors and the Department of Business.

Supporting Incubators and Accelerators

Startups invariably begin life without revenue and short of working capital. They need the cost-efficiency of services that are provided to groups assembled in a common space. They also need business advice from experienced mentors and benefit greatly from proximity to those in similar circumstances. These factors explain the essential role in the startup ecosystem played by organizations that provide those collective services—“accelerators and incubators”.

External funding is needed to reduce the cost to startups of space and shared infrastructure—e.g., hi-speed web access; conference rooms—and of access to certain professional services such as legal and accounting. While a portion of the cost will be covered by the startups themselves, the balance must be provided in some combination by private investors (who may be seeking to discover investment opportunities at a very early stage) and by the public sector. Government support should be regarded as an investment in economic development in the form of essential infrastructure for the “new” economy. The support should also be seen as a necessary complement to public seed and early stage venture financing since the likelihood of return on such investment will be increased if the investee companies are well-incubated during infancy.

Private sector-led ICT incubators and accelerators now operate successfully in Nova Scotia: namely Volta Labs, Navigate and Propel (Box 3E). In addition, the Centre for Ocean Ventures and Entrepreneurship (COVE), as described in Chapter 5, will have private sector leadership, with Innovacorp delivering its incubator and accelerator programming. Recently Invest Nova Scotia announced funding to support Navigate and Propel, but neither Volta nor COVE currently have operating financial support from the Province, despite the fact that they represent, respectively, the greatest opportunities to scale the startup ecosystem and ocean cluster. Volta is a selective and elite mentoring and milestone-based program for innovation- and technology-driven entrepreneurship. It is the leading private sector incubator and accelerator in Nova Scotia, and it needs to receive significant financial support from the Province so that the innovation district, centred in Halifax, can evolve to national scale, compete internationally, and serve as the anchor platform for Atlantic Canada’s innovation economy.

Innovacorp, or possibly Invest Nova Scotia, should be sufficiently resourced, via the Department of Business, to increase financial support for Volta Labs including (non-dilutive) investor readiness and commercialization programs. Similarly, the Institute for Ocean Research and Enterprise (IORE), which may become the manager of COVE, should be funded either by Innovacorp or Invest Nova Scotia at a level commensurate with the ambition of building a world-class ocean cluster.

Innovacorp works closely with Quebec-based Cycle Capital and EcoFuel, a clean technology fund and accelerator, as well as Guelph-based Bioenterprise Corporation, an agri-tech

accelerator. This sector-specific expertise is of considerable benefit to Nova Scotia’s cleantech and agri-tech startups and should be encouraged in Innovacorp’s other investment sectors.

3E**Incubators/Accelerators for ICT Startups**

Volta: Established in 2013 by Jevon McDonald, Patrick Keefe, and Jay Currie, Volta provides space and mentorship to innovative firms with high growth potential. From its offices in the Maritime Centre in downtown Halifax, Volta runs programs and facilitates partnerships which promote the growth and investment-readiness of start-ups. Familiarity with the venture capital industry allows Volta to connect local entrepreneurs with global investors. Volta has supported over 40 resident companies, all but five of which are still in business. Collectively, these firms have raised over \$30 million in equity financing, and have hired more than 200 full-time employees. Volta’s operating budget is currently supported by ACOA and a variety of private sector partners.

Propel: Propel ICT is an example of regional collaboration in the Atlantic Canada startup ecosystem. Propel delivers its programming in conjunction with several community and investment partners, and receives funding from ACOA, the NRC, and the governments of the Atlantic provinces. Propel’s bold mission is to educate and mentor entrepreneurs with the goal of launching Atlantic Canada’s first billion dollar ICT company. Its 12-week “Launch” Accelerator aims to help pre-revenue companies learn to develop a profitable business model, identify customers, and communicate their progress to mentors and investors. Propel’s “Build” Accelerator is designed for early revenue startups that have progressed beyond the idea phase and have a viable business plan. Each “class” is limited to nine participants, and startups are selected via a competitive application process. Propel this year has held mentoring courses in Fredericton, Moncton, Charlottetown, Halifax and St. John’s and plans to add Sydney soon.

Navigate/New Dawn Centre for Social Innovation: Navigate Startup House, located in Sydney, provides office space, support, and resources for early-stage companies, as well as the ability to tap into a worldwide network of experts in the fields of business and technology. It works with organizations such as UIT Startup Immersion and Ladies Learning Code, to support startup and entrepreneurship programming for tenants, members, and the community, including lunch and learns, workshops, hackathons, and startup weekend. It is located in the New Dawn Center for Social Innovation, a mixed-use facility with sustainable working and gathering spaces that draw in and amplify Cape Breton’s creative, innovative and forward looking energies.

Encouraging Greater Investor and Market Exposure

A travel program for tech startups is needed since multi-sector trade missions are rarely appropriate for their specialized needs. Because startups can usually identify the right people to contact through their own networks and mentors, what they really need is financial support to travel when necessary to meet face-to-face with potential investors and to learn from and create awareness in target customers. The travel program currently being administered by Volta Labs with Provincial support is a step in the right direction. Innovacorp memberships in the Canadian Digital Media Network, Canadian Entrepreneurs in New England and the Telecom Council (Silicon Valley) also support travel and offer “soft landing” programs for clients. Given the crucial importance of such outreach, Innovacorp should be provided with sufficient resources to introduce an even more robust travel support program for its investees and incubator clients.

Enhancing Sales Skills

Many startup entrepreneurs, despite a great idea, enthusiasm and support, are still unable to generate the revenue needed to get their businesses off the ground. One of the main contributing factors is a lack of trained, qualified *salespeople* with an interest in business and technology. In Atlantic Canada, first-class technical skills are relatively abundant, but experienced investors report that sales skills are in very short supply. Programs therefore need to be developed at universities and colleges to impart the art and science of complex business-to-business sales, including lead generation, proposal writing, cold calling, follow-up, and the use of customer relationship management software. (Refer to Appendix V for one possible syllabus.) To complement academic training in sales, incubators—including Innovacorp-sponsored sales training through Sandler Training and Skaled Sales—should provide short-term, highly targeted sales training—e.g., as is being done at Communitech in Waterloo and less formally at Volta.

3.2 Recommendation on Incubators and Accelerators

- The Department of Business, through Invest Nova Scotia or Innovacorp, should negotiate an agreement with Volta Labs to provide multi-year operating support subject to outcome agreements, appropriate performance metrics, and financial controls. The amount and term of the funding agreement should be sufficient to provide a measure of stability as well as enough time to judge performance—e.g., \$750,000 per year over seven years. Similar funding agreements have been entered into with Propel and Navigate, and should be considered for other enabling organizations in the startup ecosystem—i.e. COVE (as described in Chapter 5), CEED, and others.
- Investments by NSFF should be incubated, as appropriate, through the Innovacorp Enterprise Centre (Health and Life Sciences), Technology Innovation Centre (Cleantech) and COVE (Oceantech). To avoid confusion, the first two should be renamed to accurately represent their focus.
- The Department of Business and the Department of Agriculture should work with Innovacorp and Perennia, the agri-tech incubator, to determine the best way to collaborate and facilitate alignment of seed and early-stage investment and accelerator programming to support the agri-tech sector.
- Innovacorp should replicate its successful relationships with out-of-province funds and accelerators—e.g., the Quebec-based cleantech fund and accelerator (Cycle Capital and EcoFuel), and Guelph-based agri-tech accelerator Bioenterprise—to develop similar relationships in other complex sectors, including life sciences and oceantech.
- Innovacorp should increase funding support provided to startup companies for travel to contact potential investors and to improve market awareness. These are areas widely recognized as significant weaknesses of the Nova Scotia startup community. In complementary fashion, PSE institutions should develop course programs in business-to-

business sales and this initiative should be complemented with more targeted, short-term training provided by Innovacorp’s incubators.

Angel Investment Tax Credit

Atlantic Canada has a dearth of “angel” capital—i.e. investment at the very early stage usually by individuals with considerable experience with startups in a specific area of technology. This is a serious short-coming because there is particular value when the investor’s money comes bundled with management and mentoring — so-called “smart money”. Business founders benefit enormously through mentorship or proximity with other entrepreneurs. Therefore, attracting experienced angel investors would generate large benefits for the Atlantic innovation ecosystem. Many jurisdictions in North America have established support for business angel investment, including front-end tax credits. Some of these credits are refundable (i.e. paid even in cases where there is no tax payment to reduce). Refundable tax credits—provided for example by the State of Minnesota—are useful to non-residents who do not pay taxes locally and therefore help to attract investment from outside the jurisdiction.

A number of authoritative reports²³ have identified the opportunity for Nova Scotia to enhance its Equity Tax Credit to more effectively support investment in startups, and to have it apply on a reciprocal basis in partnership with the other Atlantic Provinces. Since the objective is to attract both risk capital and sector experience, the credit should be made as widely available as possible and on a refundable basis—i.e. to investors not only in Nova Scotia but at least throughout Atlantic Canada, and ideally across North America. To provide greater flexibility, the range of eligible investment types should also be considerably broadened to include, in addition to common equity, convertible debentures, preference shares and unit trusts.

3.3 Recommendation on an Angel Investment Tax Credit

The Province should replace its existing Equity Tax Credit with a *refundable* Angel Investment Tax Credit targeted on high-growth, innovative companies in designated sectors to include at least ICT, life sciences and medtech, cleantech, oceantech, agri-tech, and advanced manufacturing.

- a) Raise the investment limit to \$250,000.
- b) Include as eligible instruments: common and preference shares as well as convertible debentures.
- c) Include as eligible investors: individuals, corporations, trusts and Limited Partners, and as eligible investees: corporations, trusts and Limited Partnerships.
- d) Since the objective is to attract both risk capital and deep sector experience, eligibility for the refundable credit should extend to those in any jurisdiction and not be limited to Nova Scotia.

²³ For example; various recent reports for the Province by Donald Savoie, Laurel Broten, Gilles Duruflé, and the Ivany Commission.

This could be implemented on an Atlantic-wide basis with the federal government funding the non-resident portion of the refundable tax credit. This could be achieved through the Atlantic Growth Strategy if the federal government and other Atlantic Provinces agree.

Supporting Startups Through the Atlantic Growth Strategy

There is an opportunity to take advantage of the new Atlantic Growth Strategy particularly in the context of the federal emphasis on support for accelerators and incubators.

Incubators and Accelerators in Atlantic Canada

Foundational support is needed to develop the connective tissue of innovation ecosystems for key sectors—e.g., oceantech; ICT; life sciences and medtech; cleantech; agri-food and aquaculture. This is required to raise the programming levels of Atlantic Canada’s incubators/accelerators so that they would be in a position to compete for funding from the Canadian Accelerator and Incubator (CAIP) program administered by IRAP.

The Strategic Investments and Partnerships (SIP) program of the Business Development Bank (BDC) brings together a number of partners and players within the Canadian technology ecosystem to garner financial and non-financial support for technology entrepreneurs. Mandated to strengthen and expand BDC's strategic initiatives within the Canadian VC ecosystem, the group currently focuses on strategic investments, fosters entrepreneurial development, encourages global connectivity for tech entrepreneurs, and acts as a VC industry facilitator. Atlantic Canada’s startup ecosystem needs to be part of the club. More generally, BDC should consider re-opening an office in Halifax to support investments by its IT, health and life sciences, and cleantech venture capital funds.

3.4 Recommendation on Incubators and Accelerators in Atlantic Canada

The federal government should provide funding for organizations that develop the “connective tissue” of innovation ecosystems in key sectors and clusters—e.g., oceantech; ICT; life sciences and medtech; cleantech; agri-food and aquaculture. To this end:

- a) Eligibility for ACOA funding should include both infrastructure and programming for private sector-led incubators, accelerators, and associated research facilities.
- b) The federal government should ensure that the terms of the Industrial and Technological Benefits program (see Chapter 5) provide enhanced multipliers for infrastructure and program funding for private sector-led incubators, accelerators and associated research facilities.

Fostering Later Stage Venture Capital Investment

There is insufficient venture capital available to be invested in Atlantic Canada beyond the seed and early stage. This is despite almost \$1.5 billion in exits by Atlantic Canada venture-backed companies over the past five years—\$540 million for Ocean Nutrition; \$500 million for Q1 Labs; \$340 million for Radian6; \$70 million for GoInstant; \$20 million for Compilr. A bias against Atlantic Canada by both public sector and private venture investors nevertheless seems to persist, reflecting the region’s have-not reputation. While the exceptional quality of talent in Atlantic Canada is acknowledged, the fact remains that the pools of potential venture capital and related expertise are still shallow. As part of the Atlantic Growth Strategy, the federal government should develop a program specific to the later stage VC challenge in Atlantic Canada.

The ideal solution is to create a Venture Capital Action Plan (VCAP) fund in Atlantic Canada which can both anchor local funds, and attract other VC s to invest in the region (Box 3F). An Atlantic Canadian VCAP would provide a strong incentive for Ontario and Quebec VCs to invest in Atlantic Canada to gain access to the region’s VCAP funds. An Atlantic Canadian VCAP could also support late-stage “Series B and C” investments—e.g., through a program structured so that the government entity co-invests on terms that are favourable to venture capital investors from outside the region. An incentive will be needed to attract major, highly sophisticated investors who would not otherwise be motivated to invest in Atlantic Canada either because the size of the market is perceived as being too small, or is simply not on their radar screens.

3F

The Venture Capital Action Plan (VCAP)

The Venture Capital Action Plan (VCAP) was developed to help fill gaps in the Canadian innovation funding ecosystem identified in the *Venture Capital Industry Review*, undertaken in 2011 by the BDC. Chronically poor access to risk finance for Canadian firms has been traced back to low returns and low investor confidence, reticent institutional investors, the small size of Canadian VC funds, and a shortage of experienced VC fund managers. The later stage of venture financing is in especially short supply in Canada, with the result that many firms have been sold off prematurely. To mitigate this shortfall, Ottawa allocated \$400M under the VCAP in Budget 2012. The VCAP contribution leveraged an additional \$800M in private sector investment, and led to the recapitalization of the Northleaf Venture Catalyst Fund and the Teralys Capital Innovation Fund, and the creation of the HarborVest Canada Growth and the Kensington Venture Fund. The Teralys Fund includes a \$46.5M (matching) contribution from the Government of Québec, and the Northleaf Fund includes a \$38.8M (matching) commitment from the government of Ontario. The success of the VCAP demonstrates that government participation in risk finance can, with private investors taking the lead, substantially increase the scale and sophistication of technology-based venture investing in Canada.

3.5 Recommendation on Later Stage Venture Capital for Atlantic Canada

- The federal government should continue to fund Build Ventures, a private sector-led “Series A” venture capital fund in Atlantic Canada. This could be done through further direct funding, but ideally it would be supported through a new Atlantic-based VCAP fund-of-funds.
- In addition, a “Series B and C” co-investment fund should be established, initially on a pilot basis, to co-invest in Atlantic Canadian companies on terms that would encourage participation by venture capital investors from outside the region. An Atlantic-based VCAP fund could also invest in private-sector-led seed funds in Atlantic Canada, such as the proposed “New Fund”, Pelorus, and East Valley Ventures.

Using Government Procurement to Support Nova Scotia Startups

New companies benefit greatly from an early, sophisticated customer to provide market validation and scale to begin to move down the cost curve. In smaller jurisdictions, and depending on the product, government may be the best, if not the only, suitable first customer. And if the product is aimed primarily at the government market, purchase by the home government is likely to be a prerequisite for broader acceptance. Provincial departments in areas such as health, education, municipal and environmental services have large procurement budgets and should be prepared to allocate a small portion to purchase innovative products that credibly claim to improve service and/or lower cost. For example; one-quarter of one percent of the overall budget of the provincial Department of Health would finance \$10 million of potential purchases from innovative Nova Scotia companies in medical devices, diagnostic services, or health delivery software, among many other mission-relevant applications.

There is extensive experience with strategic government procurement to foster the commercialization of innovative new products relevant to departmental mandates—for example; the long-standing Small Business Innovation Research (SBIR) program in the U.S. and its many imitators in other countries. The recent Build in Canada Innovation Program (BCIP) is another of the genre. These programs act on the “demand side” in that they provide a real market for innovative products and, dollar for dollar, are more powerful incentives to stimulate business innovation than “supply-side” programs like R&D subsidization.

It has nevertheless proven difficult, in all jurisdictions, to convince line departments to employ any part of their procurement budgets to purchase from early-stage companies. In the first place, service delivery departments like health and education do not have economic development mandates and always claim, often justifiably, to be severely budget constrained. Therefore, they have no incentive to support the province’s startup ecosystem despite benefiting in the long run both from initiatives that strengthen the economy and tax base, and from ready access to a

potentially thriving group of innovative local suppliers. Unfortunately, the near-term incentives to procure from well-established (often foreign) suppliers at lowest cost are dominant. Therefore, strategic innovation procurement can most easily be driven by budgets that are set aside specifically for the purpose. The procurement set-aside to encourage innovation could be provided from general fiscal resources outside the department's normal budget to give time for kinks to be worked out and the value of the initiative to be assessed. This should minimize initial departmental resistance. The type and scale of procurement proposed in the following recommendation should not be in violation of any trade agreements; either internationally or inter-provincially.

In the spirit of Atlantic co-operation, government procurement from innovative companies should be undertaken by all the Provinces, and be open to new companies throughout the region. The federal BCIP has recently become available to provincial departments that are willing to buy certain innovative products from Canadian companies and this provides a targeted opportunity to create an Atlantic focus. In a broadly similar vein, Nova Scotia business leaders should step up and support innovative, early stage companies with investment and/or inclusion in mature companies' supply chains. These would not be acts of charity but rather investments to strengthen an ecosystem of local suppliers to specific mature businesses or groups of businesses. This type of "mutuality" depends on a longer-term vision but is characteristic of all successful innovation ecosystems.

3.6 Recommendation on Government Procurement to Support Nova Scotia Startups

Provincial departments should have a portion of their budgets set aside to purchase from Nova Scotia companies innovative products and services that can credibly claim to improve service and/or lower cost. This could be done on an Atlantic basis, while leveraging the federal Build in Canada Innovation Program (BCIP).

Scaling-up the Atlantic Startup Community

"The State's role is not just to create knowledge through national labs and universities, but also to mobilize resources that allow innovation to diffuse broadly across sectors of the economy. It does this by rallying existing innovation networks or by facilitating the development of new ones that bring together a diverse group of stakeholders."

— M. Mazzucato, *"The Entrepreneurial State"*

The Atlantic region's innovative startup community straddles a thinly-populated geography with primary nodes in seven cities—St. John's, Charlottetown, Saint John, Moncton, Fredericton, Sydney and Halifax. Each has its own local ecosystem and the whole is supported by several Atlantic-wide institutions and programs—for example: Build Ventures, Propel, Gerry Pond's East Valley Ventures, First Angels Network, ACOA's Atlantic Innovation Fund and Business

Development Program, and other federal innovation supports delivered through the SR&ED tax credit, IRAP and the research granting councils.

This far-flung community has achieved some remarkable successes—roughly \$1.5 billion realized in several prominent “exits” over the past five years. (See two major examples in Box 3G.) But to achieve sustainable high growth, the ecosystem needs much greater scale to attract the attention of experienced venture investors, mentors and top-notch business talent²⁴.

3G**Radian6 and Q1 Labs**

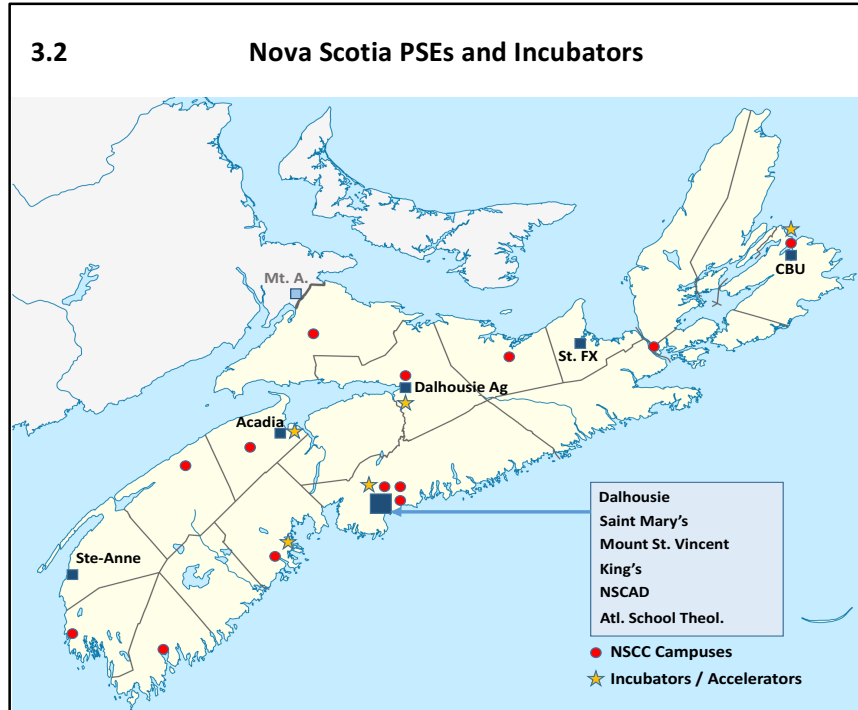
The event that truly launched the Atlantic Canadian startup community was the exit by two New Brunswick startups in 2011 – Salesforce.com’s US\$326 million purchase of Radian6, and IBM’s purchase of Q1 Labs, reportedly worth more than \$500 million. Based in Fredericton, Radian6 was a pioneer in social media analytics. Q1 Labs, which originated in Fredericton and later relocated to Waltham, MA, developed expertise in cybersecurity. These two purchases instantly meant that two of the world’s great tech companies established growing development teams in Atlantic Canada. But it also had a massive impact on the ecosystem overall. Saint John-based Mariner Partners, one of the region’s biggest IT companies, gained internal financing and developed an investment arm, East Valley Ventures. Dozens of personnel gained expertise and worked their way into other startups. And the people who profited handsomely from the exits transformed Propel ICT into the regional technology accelerator. Though these were two New Brunswick deals, their impact is still being felt strongly in Nova Scotia.

The key players in the Atlantic innovative startup community should find a mechanism to coordinate and collaborate to grow the scale and capabilities of the ecosystem, advocating for policy support and leveraging region-wide opportunities.

The Regional Innovation Network

Nova Scotia possesses an exceptional network of assets on which to build an innovative economy in the regions outside of Halifax, including an abundance of sustainable resources; strong universities and colleges that are well-distributed throughout the province; and talented individuals who, given the right digital infrastructure, can communicate globally from anywhere. These community assets are part of a network that circles the province while also having relatively easy access to a major urban centre—Halifax (Fig. 3.2). This compact geography and network can drive an innovation strategy for rural and small-town Nova Scotia.

²⁴ With respect to venture capital, the Atlantic Canadian experience has been strong. In 2014, companies in Nova Scotia raised \$51 million of the \$66 million raised by Atlantic Canada startups, which compares very well to the \$111 million raised in the three Prairie provinces. Despite having a smaller population than either Saskatchewan or Manitoba, Nova Scotia raised 12 times more venture capital; and the province raised just under one-half the venture capital of Alberta despite less than one quarter of the population.



As described in Chapter 2, the number, quality, and geographic coverage of post-secondary education institutions is a particular advantage for Nova Scotia which few regions can match. In addition to their traditional educational mandates these PSEs are major resources to promote and enable innovation and community development.

For example:

- Acadia's Centre for Rural Innovation and Entrepreneurship Centre;
- CBU's Community Economic Development Institute of the Shannon School of Business;
- Dalhousie Agricultural Campus's Rural Research Centre;
- NSCC's ten campuses outside metro Halifax, which are producing the specialized training and practical research needed to enable economic and community development throughout the province;
- Université Sainte Anne's strategic focus on sustainable rural development; and
- St. F.X.'s new Centre for Employment Innovation and the spirit of social and community innovation long represented by its internationally-renowned Coady Institute and Service Learning Programs.

In addition, CBU, Acadia, NSCC and Dalhousie's agricultural campus support "Sandboxes" which bring together students, mentors and advisers to take business and social concepts from idea to execution (Box 3H).

While innovation can happen anywhere, it still needs to be encouraged in order to fully take root. Greater networking and "density" is needed in regional centres to create the right level of interaction, as well as programming to help build an entrepreneur-led innovation community. A good example is the former Holy Angels high school in Sydney, which has been converted into a social and business innovation centre and now houses Navigate Startup House, an offshoot related to Volta Labs that was started by Sydney native and tech entrepreneur, Gavin Uhma. Cape Breton University is a partner in this ecosystem through the Uhma Institute of Technology (UIT), a startup immersion program (Box 3I). The HUB South Shore is another example of a

regional innovation centre that operates co-working space which connects progressive businesses and people together. Mashup Labs and its Spark accelerator provides “lean mentorship” to startups in rural areas. Another example is the Acadia Entrepreneurship Centre which houses the student Sandbox program and is also a regional innovation centre providing training, advisory and innovation and incubation services for individuals, businesses and not-for-profits (Box 3J).

3H**Sandboxes**

Universities and the NSCC have come together to create six “sandboxes” where students, innovators, and industry can develop new ideas that could lead to businesses. Sandboxes are based on successful approaches used at the Massachusetts Institute of Technology and the University of Waterloo. The six sandboxes in Nova Scotia are:

- *Shiftkey Labs* – Focused on ICT, this sandbox is hosted by Dalhousie University’s Faculty of Computer Science. It is a collaboration among Dalhousie’s Faculties of Management and Computer Science, Saint Mary’s University, NSCAD, NSCC, and Volta Labs.
- *Cultiv8* – Focused on agricultural innovation, this sandbox is hosted by Dalhousie’s Faculty of Agriculture. Cultiv8 is a collaboration among Dalhousie, Acadia, and the NSCC.
- *Spark Zone* – Focused on business and social enterprise, this sandbox is hosted by St Mary’s. SparkZone is a collaboration among Saint Mary’s, Mount Saint Vincent University, NSCAD, and NSCC.
- *Island Sandbox* – Focused on clean tech and social enterprise, this sandbox is hosted at CBU’s Verschuren Centre. It is a collaboration among CBU, NSCC Marconi Campus, and includes satellites at New Dawn Innovation Centre (downtown Sydney), Cape Breton Regional Library, and NSCC Strait Campus.
- *Launch Box* – Focused on developing entrepreneurs, this sandbox is hosted at Acadia University. It is a collaboration among Acadia, Dalhousie’s Faculty of Agriculture, and a wide range of partnerships including the Acadia Entrepreneurship Centre, the Rural Innovation Centre, and Université Ste. Anne.
- *IDEA Sandbox* – Focused on providing maker space and business support to engineering students, the IDEA Sandbox involves collaboration between Dalhousie and NSCAD’s Design Division.

31

The Sydney Innovation District

Much of the optimistic enthusiasm that is in the air in Cape Breton right now is the result of the highly collaborative leadership that is building the startup community and a vibrant innovation ecosystem. This “innovation district” is led by entrepreneurs with the support of Innovacorp, CBU, NSCC, the Cape Breton Partnership, and all levels of government and all First Nations. The momentum has proven to be infectious:

- CBU and NSCC: attracting and graduating students with entrepreneurial potential and serving the region as centres for research, technical, scientific and business expertise and programming
- UIT Startup Immersion: a technology entrepreneurship germinator program
- Navigate Startup House: a business incubator to host, service and provide workspace for early-stage venture development
- Island Sandbox: a partnership between CBU and NSCC for student entrepreneurship
- CBU’s Verschuren Centre for Sustainability in Energy and the Environment: an R&D service provider and incubator for clean tech companies such as Yava Technologies, Sona Nanotech
- Spark Cape Breton: an innovative ideas competition sponsored by Innovacorp
- StartUp Cape Breton: a quarterly event that is supporting the entrepreneurial movement on the island
- Cape Breton Island Futures Fund: providing early stage financial assistance and non-financial business help
- MentorConnect: supporting innovation-based and exporter entrepreneurs through long-term team mentoring
- New Dawn Centre for Social Innovation (CSI): a locus for downtown activity
- New Dawn Innovation Fund: local fund development and decision making
- Inaugural Super August: catalyzing multi-sectoral collaboration and events in the startup community
- Louisbourg Seafoods Sea++ and the community response to take this process to other sectors of the economy
- Many companies innovating daily—e.g., Marcato, MediaSpark, Orenda, Health Outcomes, HBI, Mimir.

These resources and initiatives constitute a budding innovation district in downtown Sydney, with links to CBU and NSCC, and to communities across Cape Breton. The innovation district will build out from the New Dawn CSI, which will enable CBU and NSCC to have a presence, along with UIT, Innovacorp, Navigate Startup House. The evident momentum in the startup community in Cape Breton, coupled with the synergy of the organizations collaborating to cultivate the community, provide all the ingredients needed to stimulate entrepreneurship and startups with more effective peer support networks and easy access to high-level business support.

With financial support from ACOA and the Province, local PSEs in each region could enhance the role of regional innovation centres such as Holy Angels/Navigate, the Hub South Shore and the Acadia Entrepreneurship Centre, and expand them to other areas based on these successful models. Ideally this would involve PSEs embedding their community economic support capabilities in the fabric of these regional innovation centres, and benefitting from co-location and shared resources wherever possible. In this regard, Innovacorp, NSBI and ACOA could ensure a staff presence, at least part-time, to support innovation at these centres.

Of particular importance is supporting innovation in Nova Scotia’s Mi’kmaq communities. In this regard, Cape Breton University is a national pace-setter in fostering First Nations entrepreneurship through:

- *The Purdy Crawford Chair in Aboriginal Business*: CBU is currently home to more than 300 Aboriginal students and is proud to call over 500 Aboriginal students alumni. The university has worked with Aboriginal leaders to develop the Purdy Crawford Chair to foster entrepreneurship, investment, and corporate skills training.
- *In.Business: A National Mentorship Program for Indigenous Youth*: A high school business mentorship program facilitated by the Purdy Crawford Chair and leveraging smart mobile technology provided by CBU.

3J Acadia Entrepreneurship Centre

The Centre provides training, advisory and innovation & incubation services for individuals, businesses and not-for-profits. It has an experienced team of business professionals and counsellors with more than 20 years in the field. The Entrepreneurship Centre is part of the Rural Innovation Centre (RIC), which is a collaborative environment that includes space for 8-10 “resident” companies as well as an open area with workspace for student entrepreneurs as part of the LaunchBox. The RIC also supports local businesses by providing business services, education, mentoring, and improved access to investment opportunities. The Entrepreneurship Centre has industry research centres and a focus on providing services and incubating companies in tidal energy, wine production, and ICT. It exerts a direct impact on the economic development in the Valley region by stimulating the growth of new business start-ups and entrepreneurship, while positioning Acadia University as a leader in these three sectors, and developing a commercialization environment for Acadia’s faculty, staff, and students.

Ulnooweg is the Atlantic support agency for aboriginal business leaders and entrepreneurs, and could work with Unama’ki (the economic development agency for the five First Nations communities in Cape Breton), CBU, ACOA, and provincial agencies on a particular regional innovation centre for First Nations. Building on this experience, an approach could be developed that would involve the eight First Nations on mainland Nova Scotia.

Nova Scotia’s regional innovation centres should become a more formally integrated network, sharing best practices and collaborating to contribute expertise wherever it might be needed throughout the province. Although each university and campus of NSCC will have a special role and responsibility within its local area, Nova Scotia is small enough that its PSE institutions can and should see themselves as a province-wide, networked resource where special talent and capability resident at “X” can be brought to bear at “Y” if that is where it is required.

The Halifax Innovation District

“Innovation districts” are dense areas that merge the creativity and entrepreneurship of high-growth businesses, research-oriented anchor institutions, and tech-based and creative startups. Such districts facilitate the commercial realization of new ideas and support dynamic job creation in their host economies. Innovation districts build on the intrinsic qualities of urban

cities: density, proximity, and vibrancy. But they require deliberate planning and development to achieve the unique advantages needed for the innovation economy—clustering of anchor institutions, growth-oriented companies, and cultural amenities, all concentrated in a well-identified zone.

Halifax possesses an emerging innovation district with the potential for significant scale-up to support the increased recognition and growth of the entire Atlantic Innovation Ecosystem. With a metro area population of almost half a million, Halifax also has an impressive portfolio of advantages needed to support a thriving community of innovative businesses. These advantages include the essential requirement of direct air connections to major cities in Canada, the US east coast and Europe; a regional hub financial centre; a rich endowment of educational and top-flight research institutions; an established oceans-related innovation cluster; and a vibrant startup community²⁵.

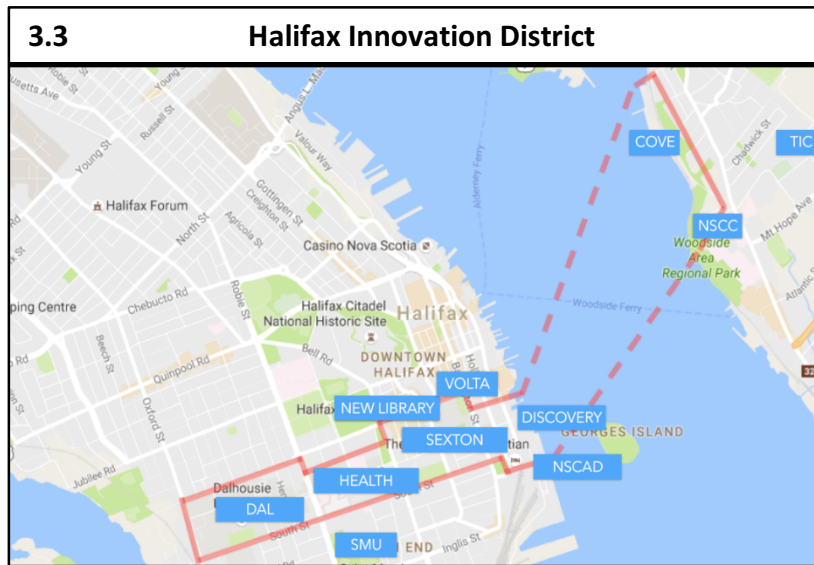
The Halifax innovation district is greatly strengthened by its synergies and connections with the other urban nodes in the Atlantic Innovation Ecosystem, which are reinforced reciprocally by connection both with each other and with Halifax. The regional character of the ecosystem is reflected in the pan-Atlantic involvement of Build Ventures, Propel ICT, First Angels Network, and the connections among leading incubators such as Volta, Planet Hatch, Venn and Common Ground. This co-operating network is necessary but not yet sufficient to create the *scale* required for the Atlantic ecosystem to compete globally.

Halifax, by virtue of its relative size, transportation links, and regional institutional infrastructure, therefore needs to play an anchoring role so that the Atlantic Innovation Ecosystem can achieve the scale needed to realize its full potential. The reward—not only for Nova Scotia but for the whole Atlantic region in view of the interconnected regional ecosystem—would be a place of real significance in the knowledge and technology dominated economy now rapidly taking shape in all the advanced nations. For this to happen, the Atlantic Provinces, with support from the federal government, must collaborate.

Clearly it is important for Canada to build on innovation strengths and scale in Toronto-Waterloo, Vancouver, Montreal and Ottawa. But today, the sky-high cost of living in centres such as San Francisco, and Boston is driving the emergence of new innovation ecosystems in the U.S. in more affordable jurisdictions such as Pittsburgh, Nashville, Salt Lake City, Kansas City, Madison WI, and Boulder/Denver. Because the situation in Canada is becoming similar—driven by rapidly rising costs in the largest centres like Toronto and Vancouver—we need to “go where

²⁵ According to the respected Branham Report, just under a quarter of the top “ICT Up and Comers in Canada” in 2015 were located in Halifax; all but one a Volta tenant. This put Halifax first, and NS second on a gross basis in Canada, and far and away the best on a per capita basis.

the puck is going to be.” Halifax is one of those places. From a portfolio perspective, therefore, Canada needs to diversify its high potential regions to include Halifax’s innovation district and the linked Atlantic Innovation Ecosystem. The region is under-recognized relative to its considerable assets, and therefore has untapped potential for above average returns on investments in its startup ecosystem.



To move forward will require a multi-year series of public and private investments to stimulate Halifax’s emerging innovation district (Fig. 3.3). This is the seed that is needed to generate growth, which creates attraction, resulting in further growth in a self-reinforcing process. Innovation districts are typically urban, rather than suburban corporate campuses and science parks that are

accessible only by car. Nevertheless, an innovation district benefits tremendously if it is readily accessible by transit to and from outlying areas. Moreover, proximity to the special character and lifestyle benefits of rural areas can be a significant advantage in attracting today’s creative talent who typically value both urban sophistication and the recreational amenities of the outdoors. Nova Scotia is fortunate in this regard because its compact geography, pattern of settlement, and resource diversity can facilitate a viable rural/small community economic strategy that offers the best of both worlds. Halifax provides urban dynamism and both direct and indirect economic support for the rest of the province, while the extraordinary resources of Nova Scotia’s rural areas and smaller communities—readily accessible to metro residents—make Halifax that much more attractive to footloose talent from around the world.

Halifax therefore has the realistic potential to host among the leading innovation districts in North America. In view of the above-noted trend toward less costly locations as the innovation economy gathers momentum, the table is set. Investment in Halifax’s innovation district will in fact be a key investment in the Atlantic Innovation Ecosystem as a whole. The resulting benefit for the entire region is due to the increased scale that Halifax can generate. And only with greater scale will it be possible to create the needed increased awareness among external investors of the startup talent to be found in Atlantic Canada.

3.7 Recommendation on a Regional Innovation Network and Urban Innovation Districts

The Province and ACOA should establish a new fund, managed by Innovacorp, to support a network of regional innovation centres in Nova Scotia and the emerging “innovation districts” in Halifax and Sydney.

- a) Innovacorp, working with universities and NSCC, ACOA, and local communities would determine the appropriate support to the regional innovation ecosystems. This should include financial support to establish or expand co-working space; the delivery of programs to foster innovation and entrepreneurship; and enhancing the role of post-secondary institutions as regional hubs for innovation and development in collaboration with the regional innovation centres.
- b) The fund should support initiatives to further develop the “innovation districts” (i) in Sydney, which is helping to catalyze innovation-driven entrepreneurship in Cape Breton, and (ii) in Halifax, which has the potential to evolve to national scale and serve as the anchor platform for Atlantic Canada’s startup community.

Annex

A Sampling of Innovative Startups in Nova Scotia²⁶

Affinio: Affinio is a pure growth story. Founded in 2013 by tech veterans Tim Burke and Stephen Hankinson, the Halifax company has drawn \$5.5 million in total investment from Build Ventures of Halifax and Whitecap Venture Partners of Toronto, among others. It has also attended some of the world’s leading mentoring programs, including Microsoft’s Seattle Accelerator. What has created all the excitement is Affinio’s advanced database technology that allows low-cost, real-time processing of social network data to determine how every person on the web is connected. It mines publicly available social media posts and other business data to find people who are connected by common interests, experiences or networks. Affinio had nine people on staff when it closed its \$4 million “Series A” VC round in November 2015, and anticipates employing 60 people by the end of 2016.

GoInstant: The success of GoInstant has attracted the world’s fastest-growing software company to Nova Scotia and led to the creation of a university program and a startup incubator. Not bad for a single company that began as a concept by a group of Cape Breton University students. The idea of developing co-browsing software was the brainchild of CBU grads Gavin Uhma, Kirk MacPhee, and Dave Kim, who shared the scheme with Innovacorp Entrepreneur-in-Residence Jevon MacDonald in 2011. They formed a company, GoInstant, which raised \$1.7 million in seed capital from Silicon Valley investors and Innovacorp. In 2012, they sold the company to Salesforce.com for more than US\$70 million. Since then, Uhma has founded UIT, which is CBU’s tech startup program. MacDonald has been the driving force behind the Volta startup house in Halifax. And Salesforce has established and grown its team in Halifax.

Halifax Biomedical: Mabou-based Halifax Biomedical Inc., led by Chad Munro, has developed an imaging device that allows two simultaneous X-rays to be taken from different angles. The system can help measure whether a patient is having problems with (joint) implant fixation, reducing the need for a recall on implants. In late 2014 the company overcame barriers to selling the device, and found clients in some major U.S. hospitals. It then moved unexpectedly quickly in gaining approval with a new product focused on imaging the spine. The company is now an ISO 13485 medical device company, which means it has the highest approval rating for medical devices in the U.S., Europe, Canada, and Australia.

SpringLoaded Technology: Chris Cowper-Smith, the CEO of Spring Loaded Technology, showed the same marketing élan in winning the BDC Young Entrepreneur of the Year competition as he did in launching his company’s Levitation knee brace. The company was formed at the Dalhousie “Starting Lean” program and since then has been working on a brace that gains energy when the knee bends and then releases it when the knee straightens, increasing the power of the joint. Having raised money from the First Angel Network, Innovacorp, and Build Ventures, Spring Loaded was able to launch Levitation in 2016. It did so in a crowdfunding campaign, and thanks to the company’s social media prowess it reached its target in the first 48 hours.

Proposify: The dozen people who work at Proposify in Halifax gathered to celebrate a key milestone in the spring of 2016 – reaching monthly recurring revenue of \$100,000. For Co-Founders Kyle Racki and Kevin Springer it probably seemed things couldn’t get any better. Then a few weeks later, Time magazine profiled the company, highlighting the tenacity of its founders. The pair started Proposify to create software that simplifies and enhances the process of writing proposals, mainly for advertising and PR agencies. It streamlines the process in the cloud with online proposal design templates that can easily be customized with text, images, videos, and charts.

WoodsCamp

WoodsCamp aims to be the world’s leading manager of timber within a decade. Given that the current leader, Weyerhaeuser Co., has annual sales of about US\$7 billion, it’s easy to see that this young startup in Mahone Bay has huge ambitions. Co-Founders Will Martin and Alastair Jarvis have devised an online portal that facilitates a market for the 60% of Nova Scotia’s woodland that is privately owned – often inherited by urban people unfamiliar with the timber trade. WoodsCamp uses open-source data from the provincial government to tell the owners what

²⁶ These vignettes were prepared by Peter Moreira for this report and have been edited slightly

they have on their lot and what it's worth. Then it connects them with people who can harvest and sell it. It creates wealth and encourages the responsible management of forests.

SimplyCast

The interesting thing about SimplyCast's July 2016 announcement that its revenues increased 37 percent in 2015 is that it made the announcement at all. The Dartmouth company, dedicated to marketing automation, makes regular announcements on its financial performance so its team of about 50 employees gets used to regular reporting. It's all preparation for the plan to become a publicly listed company. Founded by CEO Saeed El-Darahali, SimplyCast has developed an easy-to-use platform that allows marketers to launch campaigns over multiple channels. Its 360 Customer Flow Communication Platform combines marketing automation, inbound marketing, and interactive communication. SimplyCast now has clients in 175 countries, and sales have been increasing each month.

Kinduct Technologies

Travis McDonough, CEO of medical-data provider Kinduct Technologies, jogged on to the stage at the LA Dodgers Accelerator in November 2015 and delivered the pitch of his life. McDonough last autumn took the company, which has built "the world's most advanced human performance software platform" through the accelerator, which the Dodgers operates for sports and media startups. Kinduct's human performance platform can pull together disparate data on athletics and health and present them in one place. The company has the world's largest library of medical animation, which is essential in telling athletes what problem they're experiencing and how to cure it. In November, more than 50 pro teams and NCAA organizations were using the platform. McDonough says every organization that used the platform in 2014 saw a statistically significant improvement in winning percentage and a reduction in preventable injuries.

Metamaterial Technologies: Founded by CEO, George Palikaras, MTI is a smart materials and photonics company that is changing the way we use, interact with, and benefit from light. MTI is pioneering a new class of multifunctional materials which have engineered properties that go beyond what is found in nature. These materials can block light, absorb light, or enhance light. In 2014 the company struck a partnership agreement with Airbus to test and tailor its technology, Lambda Guard meta AIR, as a solution to protect a pilot's vision by blocking and deflecting intense laser strikes aimed at commercial aircraft. In the spring of 2016, MTI acquired Rolith's business, a Silicon Valley nanofabrication company, to accelerate its manufacturing of large scale metamaterial products. MTI, which previously raised money from Innovacorp, First Angel Network and the Wilmington Investor Network, is currently located in Innovacorp's incubator in Dartmouth and is working on additional applications of its platform technology including medical, LED, and solar energy.

Sona Nano Tech

Sona Nano Tech started with little more than some scientific research and a \$50,000 prize package from Innovacorp's Spark Cape Breton competition. The Sydney-based company grew out of research by St. FX professors Gerrard Marangoni and Kulbir Singh into gold nano particles that can be used in the diagnosis and treatment of soft tissue cancers. Current radiation therapy can damage healthy bone and tissue, and scientists have proven that gold nanorods – tiny gold particles – can destroy the cancer cells from inside a tumor with no harmful side effects. Marangoni and Singh discovered a cost-effective method of producing gold nano particles that requires no toxins, thereby reducing the health concerns associated with the procedure. The company, which raised capital in the summer of 2015, struck a partnership in December 2015 with Strem Chemicals Inc., which is serving as its U.S. distributor.

Compilr

When Patrick Hankinson started Compilr in 2011, he was only 23 and had already been involved in two startups. Compilr began as a company that would allow programmers to write code in the cloud rather than on a server. But the idea grew so it became an educational system that taught people how to write code. Soon, revenue was increasing 20 percent per month. In 2014, Compilr announced that it had been bought by lynda.com – the price was later revealed to be about \$20 million. Lynda was later bought by LinkedIn, which was in turn bought by Microsoft. Hankinson, now aged 28, has become an angel investor and is working on his next startup.

Chapter 4 GROWING INNOVATIVE EXPORTERS

“National prosperity is created, not inherited. It does not grow out of a country’s natural endowments, its labor pool, its interest rates, or its currency’s value, as classical economics insists. A nation’s competitiveness depends on the capacity of its industry to innovate and upgrade.”

—Michael Porter

The previous chapter focused on technology-based early-stage companies—the “green shoots” of a new economy, and for which Nova Scotia is exceptionally well positioned. But these companies, critical as they are for the province’s future, contribute only a tiny fraction of *today’s* employment and exports. Nova Scotia’s economy is still, and for years to come, reliant on a small number of relatively large established companies and a large number of small and medium size enterprises (the SMEs) distributed throughout the province and forming the economic base of much of rural and small-town Nova Scotia. This chapter addresses these companies with a focus on those that are already exporting, or have the potential to do so. The export test separates the most dynamic businesses from the rest, and exports will largely determine the province’s growth given the flat to declining population of the local market. Therefore, those businesses that succeed and grow in the global market will be the primary drivers of Nova Scotia’s prosperity²⁷.

Export performance is the acid test of competitiveness over the longer term as the impact of fluctuations in currencies and business cycles average out. Successful exporters, almost by definition, tend to be innovative and growth-oriented. Compared with businesses that only operate domestically, exporting firms on average have greater productivity, faster growth, create more jobs, undertake more innovation, and tend to have better domestic market performance as well. In short, exporters are the principal source of dynamism in every economy.

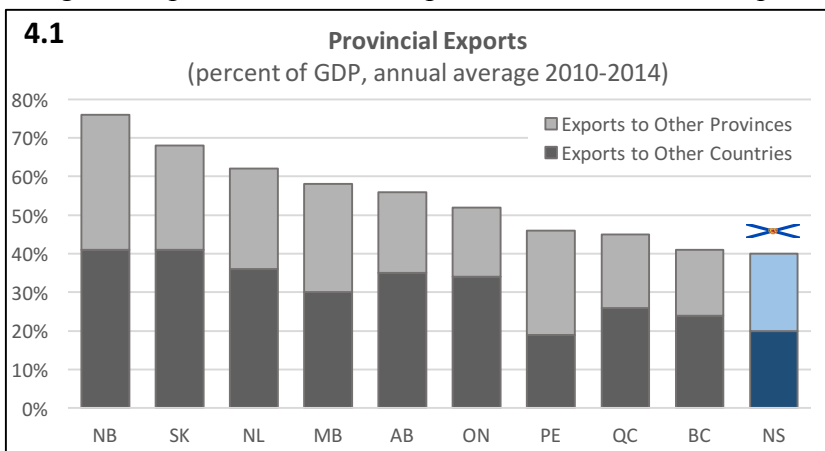
Sustained export success depends on maintaining global competitiveness—the ability of a business to sell its products on a world market at a profit, and without relying on a weakening currency. This durable form of competitiveness is determined by the performance of individual businesses and depends on *innovation*, whether to make one’s product more attractive or to make it more cost-efficiently. Based on the metric of export performance, Nova Scotia has a serious competitiveness problem—some evidence:

- Exports as a share of GDP (averaged over 2010-14) were lowest among the provinces (Fig.

²⁷ The majority of Nova Scotia’s GDP and employment (as is the case in all provinces) is generated in domestic sectors including a great deal in public services, construction and others that are relatively shielded from international competition though few, if any, are completely immune. These sectors are hugely important, and dominate the economy, but they are mostly not at the cutting edge of innovation and productivity, and their growth is largely limited by that of the provincial population and tax base.

4.1)

- On a per capita basis, Nova Scotia’s international exports (\$5.5 billion in 2015) were only 40% of the national average. (Excluding fossil energy exports, the figure was 46%.)
- The dollar value of international exports in 2015 was virtually the same as 15 years earlier, reflecting primarily a 50% decline in forest and energy products combined, offset by healthy increases in rubber products (Michelin) and seafood (Fig. 4.2).
- Nova Scotia runs one of the largest interprovincial trade deficits—18% of GDP in 2015. If the province were a country, the “Bluenose Dollar” would be under severe downward pressure.
- There are relatively few export-focused firms in Nova Scotia—only about 900 companies that register exports, of which 320 produce more than three-quarters of the total.



Apart from Michelin, Nova Scotia’s exports are overwhelmingly resource-based and thus subject to the vagaries of global prices, the health and sustainability of the resource supplies themselves, and growing concerns related to environmental impact. This is a precarious position as illustrated, for example, by the 80% decline in the value of Nova Scotia’s energy exports from \$1.6 billion in 2008 to \$0.3 billion in 2015. The traditional resource orientation of the province’s exporters also largely accounts for the very low level of business R&D in Nova Scotia—the lowest relative to GDP among the provinces. (Recall Fig. 10 in the introductory chapter.)

4.2 Principal Nova Scotia Exports by Category
(\$ Million)

SECTOR	2000	2015	\$ change
Plastics & Rubber	983.3	1,477.1	493.8
Food & Beverage Manufacturing	706.9	1,029.5	322.6
Fishing, Hunting & Trapping	527.1	884.6	357.5
Other	616.1	770.7	154.6
Wood Products, Pulp, and Paper	1,086.5	673.6	-412.9
Oil & Gas	768.9	218.9	-550.0
Transportation Equipment Mfg.	313.2	128.6	-184.6
Agriculture	37.6	124.8	87.2
Textiles, Clothing, & Leather	60.2	110.4	50.2
Mining	116.8	70.1	-46.7
Utilities	0.4	4.9	4.6
Forestry & Logging	2.3	0.6	-1.6
TOTAL	5,219.3	5,493.9	274.6

A substantial degree of resource dependence is inevitable for a place like Nova Scotia given its natural endowment and upstream, commodity-oriented position in North American and global supply chains. These are

characteristics the province shares with much of Canada. Of course, resources can underpin prosperity and be the basis for many internationally successful companies like Clearwater and Oxford Frozen Foods. But the key to mitigating the volatility of a resource economy and to sustaining growth is to add greater value to each unit of the underlying resource and to establish broadly diversified export markets. That in turn depends on the *innovation* in product, process, and market development that leads to durable global competitiveness.

There are many Nova Scotia companies of all sizes and sectors that have mastered the formula—Riverside Lobster International and Acadian Seaplants being two impressive examples among several (Box 4A, 4B). There are just not nearly enough of them. As a group, Nova Scotia exporters need to up their game substantially, as demonstrated by the dismal statistics cited above. The most significant recommendation in this chapter is therefore to create an “Export Accelerator” program to boost SME export performance.

The economy can also benefit substantially from companies that invest and locate here from other jurisdictions. They may bring technology, innovative processes and business models, access to global markets and supply chains, and of course, jobs. The export focus of this chapter is therefore complemented with observations on the Province’s approach to the attraction of foreign direct investment (FDI) and certain related aspects of the role of the Nova Scotia Business Inc. (NSBI). The competitiveness that leads to export success depends critically on the adoption of the best technologies, practices, and ideas from around the world. So this chapter also recommends measures to facilitate the diffusion of innovation into the Nova Scotia economy. Finally, in view of the growing contribution of “cleantech” to a more sustainable economy, the chapter identifies opportunities to promote the emerging cleantech sector in Atlantic Canada both to capture the environmental benefits and to support development of new export capabilities.

An Export Accelerator for SMEs

A core objective of an innovation strategy for Nova Scotia, must be to improve substantially the export performance of small and medium-size enterprises, particularly in the traditional resource sectors, in manufacturing, and in tourism (understood as an export earner). A number of spectacular success stories in Nova Scotia demonstrate what is possible—e.g., Riverside Lobster International; Acadian Seaplants; Louisbourg Seafoods; Cabot Links and Cliffs; and the introduction of the Honey Crisp apple. If examples like these could be more broadly replicated, the impact on growth, on jobs, and on Nova Scotia’s economic reputation, would be transformative.

The talent and the opportunity clearly exist. We have the success stories to prove it, but we need a lot more. Too many businesses believe that the potential reward for a significant investment in a leading-edge piece of equipment; or in product development; or in the time and expense to

enter an unfamiliar market, is simply not worth the risk. Better to stick with the tried and true rather than put one's business on the line, especially when the margin between success and failure looks slim and while the *status quo* is comfortable enough, at least for now.

4A**Riverside Lobster International, Inc.**

Based in Meteghan River, Riverside Lobster International is a textbook case of rapid growth through innovation in a traditional industry. Riverside sits beside St. Mary's Bay, an area known for its quality live lobster. Several years ago, owner David Deveau recognized that a rising share of the lobster catch in western Nova Scotia was comprised of soft shell lobsters. These were of little use to his air freight business which supplied live lobsters to the Asian market. In response to this challenge, Deveau brought together three local firms that in 2014 opened a new processing operation — Riverside Lobster International. When it began operations, Riverside had 47 employees. Today, it has more than 300 full-time employees, and processes 60,000 lbs. of lobster daily from raw to consumption ready under one roof at its Meteghan River facility. It then ships directly to retailers, using its own transportation company, complemented by warehouses in Nova Scotia, New Brunswick, and Massachusetts. Riverside sells to retailers throughout Canada, and exports to the US (its largest market), Europe, South Korea, and Japan. The company previously worked through wholesalers, but Riverside found it could be nimbler in responding to the demands of the marketplace by quickly tailoring its output to the specific product lines demanded by supermarkets.

Riverside's aggressive market expansion has been driven by technological, process, and product innovations. The company operates an innovative high-pressure processing machine, purchased from a Spanish manufacturer, which reduces pasteurization time thus increasing output while driving down operating costs. Riverside has also replaced its water cooking system with a continuous steam cooker that runs at a lower temperature and requires less fuel to operate, an innovation that is easier both on the environment and the bottom line. Determined to obtain as much value as possible from a lobster, Riverside is investigating how to extract useful compounds from the shells, such as calcium additives for the diet of laying hens. And rather than pay to simply have shells taken away for compost, Riverside is seeking ways to turn what has traditionally been a waste product into revenue. For example; the company funds research on compound extraction at Dalhousie's Agricultural Campus in Truro, and is also involved in developing a new flavouring derived from lobster shells.

The company's growth is currently constrained by a persistent shortage of workers which illustrates one consequence of Nova Scotia's demographic challenge. Immigration, and greater retention of population in rural and small town communities are needed to mitigate this problem. Nevertheless, Riverside has just spent more than \$10 million on expansion, installing new equipment and doubling the size of its plant. A success by any measure, Riverside Lobster International demonstrates impressively what can be achieved through entrepreneurship and innovation in a traditional Nova Scotia industry.

Decades of experience trying to promote economic growth in Atlantic Canada demonstrate that this conservative attitude is *very* hard to shake. There is a reason for that. It is because the attitude is in fact *rational* given expectations regarding the tradeoff between risk and reward in a chronically lagging economy (Box 4C). Acknowledging this stubborn reality is one of the most important messages in this report. It cannot be wished away and no amount of verbal chiding by pundits and policy-makers will cause most businesses to change. That is why a government program to improve the export performance of Nova Scotia's SMEs must be tightly focused on

reducing the perceived risk of an ambitious export strategy while increasing awareness of the reward and of how to achieve it. It is important initially to target businesses that have already shown some export success and/or have expressed a clear desire to improve their game. This will increase the chances of a program’s early success and thus create a *demonstration effect* that will inspire confidence and ambition in other companies. For this reason, a program to foster better export performance needs first to identify and support potentially strong businesses rather than try to prop up weak performers.

4B

Acadian Seaplants

When he discusses the impressive size of his company’s workforce, Acadian Seaplants President Jean-Paul Deveau often points out that its roughly 350 staff members include 25 research scientists. Deveau is proud of the R&D conducted by the 35-year-old Dartmouth-based company, which exports value-added seaweed-based products to more than 80 countries. The company operates five manufacturing facilities and an R&D centre in Atlantic Canada. Deveau’s father Louis first became fascinated by the properties of seaweed as a boy when he noticed his father spreading a species called *goemon de roche* on the family vegetable garden in Baie Ste. Marie, NS. Louis went on to become the president of Marine Colloids, a multinational based in Rockland, ME, and eventually bought out the company’s Canadian assets. Jean-Paul Deveau joined the company in 1985, and together they grew it into a multinational enterprise. Today, the company has many divisions, the biggest of which is its plant science division, which produces globally exported crop biostimulants. Meanwhile, specialty-food products are a growing part of the business.

4C

Why Too Many SMEs Don’t innovate—a 1990 Perspective

In a 1990 study for ACOA and the Province, Professor P.N. O’Farrell (a business economist at Heriot-Watt University in Scotland) made the following observations that, unfortunately, remain relevant 26 years later.

“Despite their lower productivity compared with the matched New England firms, and their underutilization of machinery, profitability of the Nova Scotia firms, with the exception of fish processing, is comparable with that in New England. Given that most of the Canadian businesses sampled were profitable, it is privately rational for management to make relatively lower quality, expensive products with little or no design or R&D input. There would be large social benefits if the Nova Scotia labour force was trained up to American standards but a portion of this benefit would be taken out in the form of higher wages rather than increased profitability. [...] There is an apparent paradox that Nova Scotia firms are profitable despite lower productivity, and a lack of competitiveness. This is not desirable from a policy perspective given that in this position of market failure, management in Nova Scotia is behaving rationally in not implementing those changes (increased training, more research and development and product innovation and higher productivity and product quality) which are necessary for sustained long run growth. [...] The diagnosis again leads back to the need for policy makers to shift their emphasis away from subsidies for fixed asset investment towards human capital assistance.”

Small Manufacturing Competitiveness and Performance: An Analysis of Matched Pairs in Nova Scotia and New England. (March 1990).

Responding to the foregoing diagnosis, it is proposed to create an “Export Accelerator” program, addressed to small and medium size companies, and described in broad outline below.

First; some definitions and context. For purposes of this discussion, Nova Scotia’s “SME

exporters”²⁸ fall into three broad categories²⁹:

- *Dynamic firms*—those that are already growing and productive, investing in innovation and exporting widely, but have the potential to scale and become large companies.
- *Opportunity firms*—those with global growth potential but are less productive, investing insufficiently in innovation to compete globally, and have shown limited export ambition.
- *New exporters*—those with global growth potential but are not currently exporting, and therefore will need to understand how to become productive and innovative to compete in export markets.

Most SMEs are busy, with their heads down intently focused on day-to-day operations and keeping the bottom line in the black. Pressed for time, many do not know very precisely their current competitive position, or where they need to invest in order to succeed globally. Many are not aware of, or do not fully understand, the export services and programs available to them or where to look for help at different stages of the export readiness process. They need direct and customized support to raise awareness of possibilities, to overcome reluctance, and to pump up ambition. Export promotion is a resource-intensive process and existing provincial and federal programs can be overwhelmed by demand from firms that are not really export-ready. Sometimes the export promotion agencies lack the on-the-ground networks needed to identify and recruit the highest-potential SMEs into the export services system. In addition, many government-run export development agencies do not have the private sector expertise to advise and mentor exporters looking to scale globally. The outline of a program designed to address the foregoing needs and opportunities follows:

Proposed Features of the Program

A private sector firm (the “Accelerator”)—e.g., McKinsey, BCG, Monitor Deloitte and/or other top-tier consulting firms with a global reputation—would be engaged to develop and run an “Export Accelerator” program for SMEs. The objective is to help companies enhance their export ambition and competitiveness and thereby generate much greater export growth in Nova Scotia.

- a) Program participants (“Participants”) would be selected, upon application, based on assessment of likelihood to benefit, including, for example, the commitment of the CEO and metrics demonstrating growth, investment and willingness to pursue broader export opportunities. The Program aims to build on potential strength.
- b) The Participants would be mentored by entrepreneurs and senior executives (“Mentors”) that have significant export business experience. Often these highly qualified individuals want to help others, but their assistance needs to be well-structured to fit with their available

²⁸ The term “SME exporters” as used here does not include high growth technology startups, although the latter are also export firms that are born global. Here, we are focusing only on SME exporters that are manufacturers, processors and service companies in other sectors, which can include rural and resource companies.

²⁹ Deloitte (2013). “The Future of Productivity: A Wake-Up Call for Canadian Companies.”

time. The Program would provide that structured opportunity for the Mentors and ensure actionable, real-world advice for the Participants.

- c) A Participant, Accelerator and Mentor would collaborate to: (i) understand the competitive export landscape and emerging opportunities; (ii) determine what the company needs to do to become globally competitive; and (iii) develop a plan to succeed as an exporter including assessing the requirements for people and investment in ICT, equipment, and R&D.
- d) The Accelerator would work with each Participant to support implementation of a *customized* business plan and bring in trade and market specialists to advise on the nuts-and-bolts realities of implementation.
- e) Because building sustainable export capability takes time, the Program will need to be multi-year (e.g., 3 years’ participation per company) with the Participants belonging to an annual cohort meeting at intervals to review progress, update business strategy and operational plans, and share accumulating experience with others in the cohort. The 3rd year should include visits to the target markets to crystallize the export strategies that have been developed.
- f) The Program would be sector agnostic apart from its export focus. There will be different program structures tailored for each type of SME exporter: the Dynamic Stream, the Opportunity Stream and the New Exporter Stream.
- g) The number of Participants would initially be quite limited—e.g., 10 companies spread through the three categories. Participants that turn out not to be fully committed and making progress toward agreed milestones would be cut. Only a genuinely committed group would “graduate”.
- h) The existing federal “Accelerated Growth Service”³⁰ would help Participants access current federal programs.
- i) Participants and graduates of the Export Accelerator program should be preferentially eligible for certain government programs, including a (proposed) new “Export Accelerator Fund” to provide customized funding through grants and/or loans to promote export success. This would be a further powerful incentive to apply to the Export Accelerator program and, if selected, to participate at a senior level.

Benefits of the SME Export Accelerator Program

The objective of the program, and the measure of its success, will be a significant and sustainable improvement in the export performance of Nova Scotia’s small and medium-size businesses. The program will contribute to this objective by:

- Building awareness of market opportunities backed-up by practical, customized advice from experienced exporters in order to instill *confidence* that ambitious export objectives can be achieved. (Business mentors who have had on-the-ground experience will be the key to

³⁰ The Accelerated Growth Service is a collaboration among several federal departments and agencies-- Innovation, Science and Economic Development Canada, Global Affairs Canada, BDC, EDC, IRAP, and the regional development agencies (e.g. ACOA).

credibility.)

- Supporting planning and investment in the skills, equipment and intangible assets (e.g., data bases, business processes, R&D) needed to achieve the export objectives of a participating company. This would be accomplished by guidance in assessing existing government programs and by financing provided by a proposed “Export Accelerator Fund”.
- Generating, via the demonstration effect, a new success dynamic among Nova Scotia SMEs as more and more graduates of the program achieve ambitious export goals. Because the program is selective, targeted on strength, and delivered by world-class experts, it will confer prestige and create a strong incentive to be selected and to graduate. Eventually a *tipping point* would be reached where skepticism evaporates and everyone wants “to get with the program”.
- Creating an environment in which participating companies share experience and insights that will (i) significantly amplify and complement the mentored aspect, and (ii) result in an on-going network of relationships among program graduates themselves as well as with mentors and thus continue to deliver benefit long after the formal program experience.

Considerations regarding implementation

The Export Accelerator program should be managed by NSBI in collaboration with, and partially funded by, ACOA. The actual delivery of the program’s content and expertise would be the responsibility of the Accelerator and Mentors. It is emphasized that the main distinguishing feature of this program will be the quality and reputation of the “faculty”. Accelerator and Mentors have to be genuinely world-class. Otherwise the Participants will not be attracted and sufficiently committed; the best Mentors will not devote their valuable time, and the ambitious objectives of the program will not be achieved. The selected SME participants would be expected to cover a portion of the cost of the mentored aspect of the program in view of the substantial individual benefit conferred. The first-year cost should be largely covered by government in order to encourage participation. Participating companies should bear an increasing share of the cost of participation in years two and three as the value of the experience becomes well-established.

The cost of the program, apart from funding for the proposed new Export Accelerator Fund, would be primarily (a) to retain the private sector consulting services (the “Accelerator” and the “Mentors”) (b) to host meetings and (c) to assign new government resources, if necessary, to provide oversight. The largest expense will be for consulting services since these must be of the highest quality and will be expected to prepare diligently for each meeting and provide on-going support via advice tailored to sectors and capabilities of Nova Scotia businesses and to specific market opportunities. This would not be a cookie-cutter exercise, although as experience is gained, the preparation required of the consultants would be reduced. The Accelerator might be paid through a modest “base fee” plus an outcome-based amount that would reward substantial increases in exports.

4.1 Recommendation on the Export Accelerator Program

In collaboration with ACOA, the Province should establish an Export Accelerator program. The objective is to significantly increase the export ambition and capabilities of selected SMEs through an intensive multi-year program of export strategy development and tutelage led by world-class experts. The program would have the following key features:

- a) Developed and run by an international consulting company of the caliber of, for example, McKinsey, BCG, Monitor Deloitte;
- b) Available, based on selection, to SMEs that demonstrate a willingness to improve export performance and have the potential to do so;
- c) Organized in annual cohorts of companies (e.g., 10 at a time) that would meet periodically for three years under the guidance of the consultants and selected mentors who have extensive export experience and will be able to provide customized and experience-based advice related to specific sectors and potential markets;
- d) Supported by a new “Export Accelerator Fund” to provide customized financial support through grants/loans to promote export success;
- e) Graduates of the program to be given preferential consideration in accessing certain government programs that aim to build export readiness;
- f) Participating companies to bear a share of the cost with the government assistance front-loaded to encourage initial up-take. A portion of the Accelerator costs could be performance-related based on the growth in Participants’ exports.

NSBI would administer the program in Nova Scotia in close collaboration with, and shared funding from, ACOA.

Although the Export Accelerator Program is described here in a Nova Scotia context, it would have similar benefits throughout Atlantic Canada and could be expanded as part of the Atlantic Growth Strategy, perhaps following a pilot in Nova Scotia.

Acquiring Innovation via Foreign Direct Investment

Foreign direct investment (FDI) in support of economic development can occur through the establishment of a new corporate presence or the expansion of an existing enterprise as, for example, Michelin has done on several occasions (Box 4D). The benefit of FDI, beyond the jobs directly created, comes through the embodied technology and other forms of innovation, together with the expanded market access that the investing company can bring. The latter characteristics are the source of the durable competitiveness that Nova Scotia needs. The catch is that globally footloose companies—the typical targets of FDI attraction programs—are inevitably in a strong bargaining position to extract the best incentives from the competing host jurisdictions. Such companies often have only a shallow commitment to the investee location and are at risk to leave when incentives expire or the economy hits a rough patch.

FDI is most reliable and most likely to generate long-term growth when it is motivated by particular characteristics of the host location—for example, in Nova Scotia’s case by a stable and reasonably well-educated workforce; an excellent network of post-secondary institutions to supply talent and R&D capabilities; direct air connections to the US northeast, central Canada, and Europe; and a cost-competitive and trustworthy business environment. Competing jurisdictions will of course claim many similar advantages. Often in the end, the competition comes down to a direct *financial* incentive, which in Nova Scotia’s case is principally the “payroll rebate”, an inducement managed by NSBI and which costs on average about \$12 million a year (Box 4E).

4D	Michelin
<p>Michelin, the French multinational, established production facilities in Nova Scotia in 1969, and has since grown to employ nearly 4,500 in Granton, Bridgewater, and Waterville. Attracted by the skill and work ethic of Nova Scotians, Michelin has continued to expand its presence in the province, investing nearly \$2 billion over of the past several decades. The increased production of car, truck, and bus tires has led to “rubber” becoming the province’s largest export industry, ahead of fisheries and food and beverages. Over the years, the provincial government has supported Michelin’s steady expansion with a combination of loans and grants. For example, in 1988, the Province approved a \$48.3 million loan to support Michelin’s \$500 million expansion, with \$25 million of that loan forgiven in 1997 when the company committed \$150 million to upgrade existing facilities. In 2014, Michelin created a small-business loan fund to mitigate the effects of a large layoff at its Granton plant. The fund provides low-interest loans of up to \$300,000 to small business and startups in areas affected by the layoff to stimulate economic growth and create new employment opportunities. The almost half-century partnership between Michelin and Nova Scotia is a textbook case of a mutually beneficial relationship between business and government, and also a demonstration that, with the right partner, world-class manufacturing can be viable in small-town Nova Scotia.</p>	

Although operating subsidies may initially attract a corporate investment, they do not, in themselves, build durable attachment to Nova Scotia. Furthermore, because the province is already a relatively low-cost location, wage subsidies effectively double-down on an existing advantage and risk joining a “race to the bottom” with jurisdictions that have little else to offer. Nevertheless, the unfortunate reality is that a financial inducement may be needed to *close* an FDI deal that is important for Nova Scotia and that offers good prospects that the investing business will become well-rooted here. Among the financial incentives for FDI, the payroll rebate is well-designed and has a continuing role as part of a larger bundle of inducements. Having said that, the Province’s FDI attraction strategy needs to place greater emphasis on tools that will appeal specifically to innovative, ambitious companies, since these are the kind of investors Nova Scotia most needs to attract.

One such potential incentive could be modeled on the existing “Productivity and Innovation Voucher”. Unlike a wage subsidy that flows back to the investor’s bottom line, the voucher is in effect a transfer from the government to a Nova Scotia entity (that performs the work for which the voucher is payment), but of benefit to the investor as a subsidy for innovation. The existing program, managed by Innovacorp, is intended to encourage SMEs to work collaboratively with universities and colleges. The recipient businesses use the vouchers (which have a maximum value of \$25,000) to “purchase” services such as applied research, engineering work, prototyping, market advice, and field testing. In 2016 there were 167 SME applicants, 35% of which received vouchers worth just over \$1 million.

4E

The Payroll Rebate and Investment Attraction

NSBI’s “payroll rebates” reward the creation of good jobs in Nova Scotia. For every dollar a qualifying company spends on salaries and benefits, NSBI rebates between five and ten percent. The employer does not receive the rebate until it can prove that a designated number of new positions have been created. The payroll rebate is targeted to knowledge-based firms in high-growth sectors. In the past, NSBI has courted the finance and insurance, ICT, and defence industries; the 2016-17 strategy focuses on companies in ICT, oceans, seafood, and agri-food.

The case of IBM’s Global Delivery Centre in Bedford, which opened in 2013, provides a good example of how a package of incentives and mutual commitments combined to attract a global tech-based employer to Nova Scotia – in this case, the combination of a major contract, a commitment to training, and finally a payroll rebate. The provincial government became the new Centre’s first large client, outsourcing its SAP system, transferring administration of payroll, human resources, and procurement data. IBM has stated that having an anchor client in the region was essential for the Centre’s development, showing how important government procurement can be in attracting innovative businesses. The 10-year contract with the Province is worth about \$8.4 million per year and if IBM reaches its employment target of 500 jobs by 2020, the Province has agreed to rebate up to \$12.2 million through payroll rebate. Estimated provincial income tax revenue from IBM’s payroll, if the employment target is reached, would be \$18.7 million. As part of the agreement, IBM announced that it would spend \$3 million on a collaborative computing centre at Dalhousie to increase the pool of employment talent. It is also making efforts to collaborate with NSCC and other post-secondary institutions in Nova Scotia to enhance SAP training. Graduates will be prepared not only to work for the new IBM Global Delivery Centre, but also to contribute to Halifax’s emerging ICT cluster.

The existing Productivity and Innovation Voucher—the “SME voucher”—should be retained while a second voucher—the “FDI voucher”—should be created to serve as an incentive to attract FDI prospects and could be redeemed, for example, to purchase training for specialized skills and/or acquisition of customized equipment and services from a variety of Nova Scotia providers. Since the FDI targets are typically large companies, the upper limit of this second type of voucher should be substantially greater than that of the SME voucher. The FDI voucher could be funded by reallocating a portion of the amounts that would otherwise be spent on the payroll rebate. This might begin with an allocation of 25% (about \$3 million based on the current expenditure on the rebate), and then increased, or potentially cut back, depending on experience.

Both voucher instruments should be managed by NSBI—the FDI voucher for obvious reasons; but there would also be virtue in moving the existing SME voucher from Innovacorp to NSBI since it is not primarily aimed at the startups that are Innovacorp’s main clientele. More important going forward, the mandate of NSBI should be broadened beyond FDI attraction and export promotion to include the support of innovation and productivity since these are necessary to boost the export competitiveness of SMEs. From this perspective, the voucher tool would complement the proposed Export Accelerator program as part of NSBI’s extended mandate. Since many of the other tools to encourage productivity and innovation are federal or provincial programs—such as LAE’s Workplace Innovation and Productivity Skills Incentive, ACOA’s Atlantic Innovation Fund, and NRC’s Industrial Research Assistance Program (IRAP)—NSBI should be evaluated on how often it refers businesses to successfully apply to such programs. To this end, consideration should be given to co-locating a number of IRAP Industrial Technology Advisors and ACOA Field Officers with NSBI to ensure complementary service delivery and to be better able to share field intelligence regarding joint client firms.

4.2 Recommendation on Incentives for Foreign Direct Investment

NSBI’s FDI attraction strategy should complement the payroll rebate with greater emphasis on incentives designed to attract more innovative companies. To that end:

- a) The Province’s Productivity and Innovation Voucher program should be expanded to include a second component designed to serve primarily as an FDI incentive, redeemable for purchase from Nova Scotia providers of services that would be attractive to innovative companies. Management of both the existing voucher (which is targeted at SMEs) and the new voucher should be the responsibility of NSBI whose mandate should be broadened to include the support of *innovation and productivity* of its client companies.
- b) At least 25% of the annual expenditure on payroll rebates (currently about \$12 million) should be allocated to “FDI vouchers”, or other credits, to be redeemed for the purchase in Nova Scotia of goods and services that will enhance the innovation objectives of the investing company—for example: customized training and skills development; R&D collaborations with post-secondary institutions; acquisition of customized equipment and services; investing in, or procurement from, innovative startups; integrating Nova Scotia companies into global supply chains.
- c) The portion of the FDI incentives offered through payroll rebate should be decreased over time depending on experience with alternative innovation-oriented incentives.
- d) The payroll rebate should be made more strategic by complementing the standard rate with an enhanced rate for hiring highly qualified people or people from certain groups that are under-represented in the workforce.

Considerations relative to the Atlantic Growth Strategy

Some of the most successful approaches around the world – Israel’s OCS, Finland’s Tekes, Enterprise Ireland, U.S. SBIR—provide generous grants to business (50% or more) for

innovation, including both for R&D and for subsequent commercialization. The emphasis in Canada has been on tax-based assistance (the SR&ED credit) with a repayable feature for early-stage companies that may not have taxable income. Several observers have suggested that Canada's R&D assistance should be re-balanced with a much greater proportion delivered via targeted grants³¹. In that spirit, through the Atlantic Growth Strategy, changes could be made to the AIF Program to support R&D and innovation projects between \$500,000 and perhaps \$5 million (an increase from \$3 million currently). The program might also be applied with greater flexibility for business-driven innovation projects that are further toward the "development" end of the R&D continuum; and the AIF's "repayability" experience should be reviewed to determine if a portion of AIF assistance might be structured as a grant so as to increase uptake but with little or no ultimate impact on net cost to the government.

Stimulating the Diffusion of Innovation

Innovation flows from the point of origin into the economy via the process of *diffusion*. In fact, innovation is of little significance economically unless and until it spreads widely. A business or a province or a country is considered to be "innovative" if it is regularly among the early and successful adopters, and not just the inventors, of the new technologies and best practices that translate into superior competitiveness. Adaptation of innovations that originate elsewhere can stimulate further innovation through training, the redesign of business processes, and marketing to fully capture the benefits and create new value.

Perhaps the most successful innovation diffusion policy of all time was the set of measures developed in the U.S. in the late 19th century to bring agricultural science and technology to the family farm. This was accomplished through the establishment of a system of ("A&M") universities specialized for the task, complemented by an extension service of trained "ag reps" who brought new knowledge and techniques to farmers, face-to-face. This comprehensive policy played a major role in the agricultural productivity revolution during the first half of the 20th century; and to this day, productivity growth in agriculture is consistently among the highest of any sector in the North American economy.

The lesson of this remarkable experience is that the most effective way to enhance productivity growth is to increase the rate of up-take of the global stock of innovation that is embodied in capital equipment, software, and in a growing array of intangible forms related to business processes, organizational models, marketing methods, and so forth. The diffusion of innovation

³¹ The largest federal innovation support program by far is the SR&ED tax credit which represents a "tax expenditure" of about \$3.5 billion annually. Canada delivers a larger fraction of its innovation support for business through such indirect means than almost any other OECD country. The "Jenkins Panel", in its 2011 review of federal support for R&D (*Innovation Canada: A Call to Action*), recommended a rebalancing toward more direct funding support measures.

from firms and research institutions on the “global frontier” is the means by which lagging regions and sectors can close the gap with the leaders, or at least avoid falling farther behind.³²

Businesses themselves are the main agents of innovation diffusion, a process that has been dramatically facilitated by the internet, Google, and a bewildering array of specialized sites. Indeed the problem today is less to find information on specific innovations than to cope with its oversupply. That is one of the reasons why face-to-face engagement remains essential for the effective diffusion of innovation. Here there continues to be a critically important role for public policies and programs. Examples include the IRAP program and sector-oriented Institutes of the National Research Council. The research and education activities of post-secondary institutions are of course among the most pervasive and effective agents of innovation diffusion, primarily through advanced graduates, trained at the leading edge of their fields. The recommendation, earlier in this chapter, regarding the Export Accelerator program is fundamentally aimed at increasing the up-take by SMEs of the leading-edge practices needed to become a globally-competitive exporter. In a similar vein, Nova Scotia’s FDI attraction strategy should target companies that are at, or near, the global frontier of innovation since their presence in the province will facilitate innovation diffusion to the adjacent business community.

The message to be taken from these examples is that a strategy to upgrade the global competitiveness of Nova Scotia’s businesses must be founded on policies and programs to promote the more rapid and effective diffusion of innovation into the province’s economy. What follows are three quite specific measures to this effect in addition to the recommendations earlier in this chapter.

Supporting Innovation Discovery Missions

NSBI’s Export Growth program, which assists firms with costs related to in-market export activities, should be expanded, and include funds earmarked for “innovation discovery missions” to help firms identify first-hand the best ideas from around the world. Recall that the introduction of the Honeycrisp apple to Nova Scotia was the result of such a mission, though undertaken in the face of an industry crisis. It should not need to come to that. The best example of a strategy to support innovation discovery via missions abroad was undertaken by Japan in the post-war years through the 1980s. Japanese businesspeople and government officials combed the industrialized countries, and particularly the United States, absorbing technology and business practices to be applied and improved upon at home in order to accelerate the conversion of post-war Japan from an industrial backwater to a global power.

³² It will surprise many that the per capita GDP of Nova Scotia (and the other Atlantic Provinces) has grown faster, on average, than that of Ontario over the past several decades—e.g., NS increased from less than 75% of Ontario GDP per capita in 1994 to 80% in 2014. This has not been not due to transfer payments from Ottawa—those do not show up in GDP—but is almost certainly due to diffusion of innovation into the Nova Scotia economy, via technology and business practices, from Ontario, the U.S. and elsewhere in Canada and abroad.

Promoting Digital Technology Adoption by SMEs

The federal budget in 2011 funded, on a pilot basis, the Digital Technology Adoption Pilot Program (DTAPP) designed to boost the productivity of SMEs by promoting their adoption of digital technologies. The DTAPP provided financial assistance to SMEs through non-repayable contributions (to support labour costs) for projects related to the adoption of digital technology. The program was delivered by IRAP between November, 2011 and March, 2014. It was then discontinued without public explanation, and despite an internal NRC evaluation in 2013 which recommended making the program permanent. The evaluation found that DTAPP was well suited to address many of the barriers Canadian SMEs face in adopting digital technologies, an area where Canada has long trailed far behind the U.S. It is time for another try.

Encouraging the Diffusion of Cleantech

“When the winds of change blow, some people build walls and others build windmills.”
—Chinese Proverb

“Cleantech” is a blanket term to denote a wide array of technologies that increase energy efficiency, reduce pollution, mitigate GHG emissions, and generally moderate the environmental impact of human activity. Cleantech is at the core of the “sustainability” paradigm and is therefore destined to be a global growth industry for many decades to come. Cleantech presents new opportunities to create innovative businesses (as described in Chapter 3) but can also contribute to the efficiency of established businesses—e.g., by cutting energy or material consumption. Sometimes a cleantech solution will be needed to meet increasingly stringent regulatory requirements, or a *de facto* requirement to be acceptable to consumers. For these reasons, the diffusion and adoption of cleantech by businesses and institutions in Atlantic Canada can boost competitiveness while at the same time contributing to public environmental objectives.

To encourage more rapid diffusion and adoption of cleantech, the federal government could create an Atlantic-wide “Cleantech Adoption Program”. This would likely be delivered through IRAP and ACOA –similar to the proposed digital technology adoption program – but could also involve provincial partnerships with, for example, Invest Nova Scotia, NSBI and/or Efficiency One (formerly Efficiency Nova Scotia) in this province. The program would provide financial support for expert consultation and sustainability audits, as well as a financial incentive for cleantech investment via a grant/loan mechanism. In addition to reducing costs for business, especially in resource-based industries, this could also help the province achieve long-term energy sustainability while improving health and environmental outcomes. The federal government appears to recognize the importance of technology diffusion to support GHG reduction, and has proposed a two-year \$2 billion Low Carbon Economy Fund to achieve significant reductions. This fund could provide some support to an Atlantic Cleantech Adoption Program.

4.3 Recommendation on Support for More Rapid Diffusion of Innovation

- NSBI should expand its Export Growth Program to include “innovation discovery missions” to help smaller firms travel to learn first-hand of the best relevant ideas from around the world.
- The federal government, through ACOA and IRAP, should introduce an Atlantic-wide “Digital Technology Adoption Program”, targeted at export-ready SMEs. (This would be a re-establishment, at a regional level, of a similar pilot program that was discontinued by the previous federal government in 2014 despite a favourable evaluation.)
- The federal government, in partnership with the Provinces, should introduce an Atlantic-wide “Cleantech Adoption Program” to encourage more rapid and extensive business investment in cleantech. Funding could come in part from the federal government’s Low Carbon Economy Fund.

4F Atlantic Wine Institute

Based at Acadia University’s Centre for Rural Innovation, the Atlantic Wine Institute brings together businesses and academic researchers for the common purpose of supporting Nova Scotia’s dynamic grape and wine industry. Established in 2012, the Institute facilitates collaboration between sectors in which Nova Scotia has a remarkable competitive advantage. At the Wine Institute, the province’s PSEs work side-by-side with the ten wineries clustered around Wolfville and others throughout the province. The Institute has been resourced by Acadia, NSCC, Dalhousie’s Agricultural Campus, Saint Mary’s University, Holland College in PEI, Collège communautaire du Nouveau-Brunswick, the Winery Association of Nova Scotia, and the Grape Growers Association of Nova Scotia. The Institute also collaborates with Brock University’s Cool Climate Oenology and Viticulture Institute, which plays a similar role as a bridge between the academic and the private sectors in the Niagara Peninsula’s wine cluster.

Rural and Resource-based Innovation

The population of most rural areas throughout North America has been in decline for decades as the structure of the economy has evolved from its former base in land and resources toward services and amenities that concentrate naturally in urban areas. This long-term movement of people has been amplified by the extraordinary productivity gains brought about by innovation in agriculture and all other resource-based and manufacturing industries.

While these facts of history must be taken as given, the land and sea-based activities in Atlantic Canada are far too valuable, in both economic and socio-cultural terms, to be simply left to decline past the point of no return. But since the march of technological innovation cannot be turned back, it needs instead to be embraced to enable much greater value to be earned from the region’s resources, among which must be included great natural beauty and cultural charm. By bringing innovation and export market development fully to bear on Atlantic Canada’s resources, their value can

be vastly increased so as to generate the income growth needed to stabilize, and then reverse rural decline (Box 4F). There are many examples of businesses in rural Atlantic Canada that

demonstrate what success can look like (Box 4G). They show that if we are held back, it is not for want of possibility.

The Atlantic Growth Strategy has articulated an approach to rural development that mirrors themes emphasized throughout this report. The Strategy, in respect of Atlantic Canada’s rural and small town economy, is focused on:

- supporting innovation and spurring value-added opportunities in established industries like the fishery, agriculture, minerals and forestry which remain foundations of Atlantic Canada’s economy;
- enhancing research and innovation in areas such as biosciences, aquaculture, ocean technology, renewable energy, fisheries, agriculture and forestry;
- investing in regionally significant infrastructure projects, including broadband connectivity;
- developing a strategic and collaborative approach to tourism.

<p>4G</p> <p style="text-align: center;">Cabot Links and Cabot Cliffs</p> <p>While Cabot Links debuted as the 42nd best golf course in the world in Golf Digest’s rankings in 2014, its sister course one-upped it, ranking as the 19th best in the world in 2016. In a story reminiscent of “Field of Dreams”, Ben Cowan-Dewar turned an abandoned coal mine site in Inverness into a signature destination for golf enthusiasts, celebrities and travelers looking for truly world-class experiences, essentially transforming the economy of the entire western side of Cape Breton. Cabot now employs over 300 staff and has 240 caddies roaming the fairways. With upwards of 40,000 rounds of golf played in the 2016 season and occupancy at an all-time high, the demand is there for continued growth in Inverness County. With improvements to roads and other infrastructure, the community façade program in full bloom, and an influx of people working, living, and building in the community, the rural revival in Inverness is showing no signs of slowing down.</p>
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Tourism and Culture

The foregoing objectives align closely with recommendations earlier in this report, several of which call for support in the context of the Atlantic Growth Strategy. One important theme that has not been addressed explicitly in earlier chapters is the need to take a more strategic and collaborative approach to tourism, and more generally, to development of the cultural industries. This represents a

significantly under-exploited opportunity in Atlantic Canada. But it will require a major upgrade of the visitor experience with much greater emphasis on experiential elements including high-quality local cuisine; wilderness and coastal recreation; interactive forms of engagement with the region’s history; more events that showcase the region’s cultural richness. When considering government investments in tourism and cultural development, it should be recognized that the same investments that will attract more visitor expenditure from outside the region will also make Atlantic Canada even more appealing to its own residents. This would, at the same time, greatly enhance the region’s attractiveness to what Richard Florida has called the “creative class”—those individuals who are at the cutting edge of innovation. The following recommendation closely mirrors a recommendation already made by the ONE Nova Scotia Coalition.

4.4 Recommendation on Enhancing Atlantic Canada’s Tourism and Cultural Advantage

In the context of the Atlantic Growth Strategy, the federal government should establish a “Creative Industries and Tourism Innovation Fund”. In partnership with the Provinces on a shared-cost basis, the Fund would support proposals (referenced below in a Nova Scotia context) to:

- a) Establish new or enhanced festivals and events, with the goal of eventually having at least two signature events—e.g., of the calibre of Celtic Colours or the Halifax Jazz Festival—each month from May through October.
- b) Create a select number of signature destinations—e.g., of the calibre of the world-ranked Cabot Links and Cabot Cliffs golf courses.
- c) Bring the province’s wine, craft beer, and culinary experiences to a level that is unequivocally world-class. (In view of the increasing popularity of high-quality cuisine, particularly using the freshest local ingredients, Nova Scotia has an opportunity to establish itself as a global culinary destination based on an exceptional variety of seafood, boutique agriculture, and local game).
- d) Improve air access with more convenient routes to larger urban centre in Atlantic Canada.
- e) Establish “Creativity Districts” in strategically located communities that have high potential for tourism development and for attracting innovative businesses and exceptionally creative individuals—for example, Lunenburg (as a World Heritage Site), Wolfville (as a university town and centre of a developing wine industry).

Cleantech Strategy: Building the Foundations of a New Industry

Canada stands at the threshold of building our clean growth economy.... Together, we will leverage technology and innovation to seize the opportunity for Canada to contribute global solutions and become a leader in the global clean growth economy.

—Vancouver Declaration on Clean Growth and Climate Change, March, 2016

In December 2015, 195 countries, meeting in Paris, adopted the first universal, legally binding global climate agreement, setting out a global action plan to put the world on track to avoid disastrous climate change by limiting global warming to well below 2°C. Canada’s commitments under the Paris Agreement, along with the March 3, 2016 Vancouver Declaration on Clean Growth and Climate Change, and the U.S.-Canada Joint Statement on Climate, Energy and Arctic Leadership reflect an unprecedented national and international commitment to action that will catalyze growth in the environmental industries, of which the “cleantech” sector will be at the leading edge of innovation. These and other commitments being made around the world imply that cleantech will eventually become a multi-trillion dollar global market. For example, global clean energy investments hit an all-time high of US \$367 billion in 2015 – almost 50% higher than investments in fossil fuels.

In the context of the Paris Agreement (in which Canada committed to cut greenhouse gas (GHG) emissions by 30% below its 2005 level no later than 2030), the federal government has stated that all Provinces must agree to impose “a price on carbon” by 2018 or face a federal requirement to that effect. Nova Scotia has in fact already reduced its GHG emissions by 30% below their 2005 level and has increased to 27% the contribution of renewables in its electricity mix, and is on track to hit 40% by 2020. The further imposition of a carbon price—via a new tax or cap-and-trade regime—would increase the province’s already high power prices, thus penalizing one province that has already met the 2030 reduction target. There are of course ways to mitigate the impact—e.g., by rebating all, or a portion of a carbon levy to consumers and businesses in a way that preserves the incentive to reduce one’s carbon footprint. But to achieve the full potential of a national GHG reduction strategy, tools like a carbon price should be complemented with incentives to develop and demonstrate technologies that will not only reduce GHGs but also lead to new industries. Incentives of the latter type are particularly relevant in Atlantic Canada in view of the economic challenges facing the region, but also the many cleantech initiatives underway in the region on which to build.

<p>4H Verschuren Centre for Sustainability in Energy and the Environment</p> <p>Cape Breton University’s Verschuren Centre for Sustainability in Energy and the Environment delivers technology solutions to businesses, governments and communities and contributes to the economic growth both of Cape Breton and Nova Scotia broadly. It is a cleantech research and commercialization centre, providing a range of supports--contract research and training services; planning and development services; technology development and evaluation; and business incubation. It is a key part of CBU which has the distinction of being North America’s first energy self-sufficient university. Since 2012, the Verschuren Centre has incubated 8 SMEs, helped over 80 organizations in 7 provinces and 6 countries, and generated an impressive \$15 million in contract revenues.</p>	<p>4I CarbonCure</p> <p>CarbonCure has found clients across North America for its manufacturing process, which injects waste carbon into concrete, thereby eliminating the CO₂ emissions created in the manufacture of concrete products. (Concrete, the world’s most common construction material, is responsible for more than 5% of total greenhouse gas emissions because traditional processes cure concrete blocks by heating them.) CarbonCure started with concrete blocks and introduced a ready-mix product in December 2015. The company’s first client was Shaw Brick, the venerable building material company based in Lantz, N.S., which announced in July 2016 it was extending the CarbonCure technology to all its product lines. The cleantech startup has reached clients throughout the U.S. and Canada while raising less than \$10 million in funding, proving a cleantech company can succeed with manageable funding needs.</p>
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Although the scale and scope of change will disrupt industries in carbon-intensive sectors, it will also create unprecedented opportunities for new businesses and jobs in a low-carbon economy. The Atlantic Growth Strategy aims to develop a clean energy plan for Atlantic Canada by the end of 2016, and this plan should include a focus on cleantech opportunities. Atlantic Canada can be among the leaders provided there is a shared commitment among governments, business

and post-secondary institutions to pursue opportunities in those niche areas where the region, and individual provinces, have comparative advantages and/or established strengths, such as smart grid, energy storage, bioenergy, and tidal power. But converting potential advantages into realized success will not happen automatically. It will require the collaborative commitment of governments and business united with the region's post-secondary research and education capabilities.

The federal government, in Budget 2016, committed to invest more than \$1 billion over four years, starting in 2017-18, to support clean technology, including in the forestry, fisheries, mining, energy and agriculture sectors. A portion of this commitment, via the Atlantic Growth Strategy, would provide a fiscal foundation for an Atlantic Cleantech initiative as outlined below.

Tidal Energy

Nova Scotia and New Brunswick share a resource of tremendous potential: the Bay of Fundy, whose daily tides equal about four times the combined flow of all the world's rivers. The potential tidal energy from the Bay of Fundy is on the order of 60,000 megawatts (MW), of which up to 2,500 MW—enough to power all of the homes in the Maritimes—could be extracted without significant impact on the marine environment. (For more than 30 years, power from tides has been extracted through the Annapolis Tidal Generating Station.)

Over the longer-term, the potential of tidal energy is enormous but, to be realized, numerous challenges need to be overcome. The industry will require significant amounts of R&D for tidal power to become economically viable and to minimize marine environmental impact. Tidal is nevertheless one of the few sources of cleantech where Atlantic Canada has a genuine global advantage and the opportunity is far too significant to be ignored. This opportunity is supported by government policy in Nova Scotia which is aiming for 15 to 20 MW of demonstration projects before expanding to 300 MW. The Fundy Ocean Research Center for Energy (FORCE), a not-for-profit corporation in Nova Scotia—supported by the federal government, the Province, Encana Corporation, and participating developers—operates tidal turbine demonstration facilities and enables public and private research into tidal energy extraction and its effects. Four projects, including one with Emera in partnership with French giant DCNS, are currently in various stages of deployment.

Smart grid and efficient energy storage

One major enabling technology for which Atlantic Canada already has several initiatives underway is the “smart grid”, the next stage of evolution of the electricity transmission system. Smart grids employ sensors and automation technology so that electric utilities can adjust and control individual devices or millions of devices from a central location, reducing waste and maximizing efficiency of energy resources.

The single most significant barrier to the widespread adoption of clean energy solutions, such as tidal, wind and solar, is that they are intermittent, and in the case of wind and solar are to some extent unpredictable. It is well recognized that low-cost energy storage would remove this limitation, enabling virtually all of society’s energy to be supplied by renewable sources. There are many potential storage technologies—e.g., chemical storage, heat storage, pumped-storage hydro dams, compressed air, and rechargeable batteries. The latter medium may turn out to be the most significant as society turns increasingly to battery-powered vehicles. When not in use—which typically is most of the time—electric vehicles constitute a potentially vast interconnected storage system that could be managed by smart grid technology. Without cost-effective energy storage, the potential impact of wind, solar and tidal is limited. Nova Scotia has significant research capabilities that should be fully brought to bear on the energy storage challenge. The payoff from development of cost-efficient methods, both in terms of renewables enablement and of export opportunity, would be monumental.

<p>4J</p>	<p>Two Innovative Bio-energy Startups</p>
<p>Cellufuel Cellufuel converts low-value forestry by-products (wood chips, sawdust, and so on) into liquid diesel for the refinery market. Its product is chemically indistinguishable from petroleum-based fuel and is compatible with existing fuel infrastructure and engines. Wood is 80% efficient when converted to diesel, but only 20% efficient when burned conventionally. Led by a team of seasoned forestry and private equity executives, Cellufuel is preparing a large demonstrator facility at the former Bowater Mersey paper plant near Liverpool. The company has benefitted from public and private sector support: in 2014, it received a \$270,000 investment from Innovacorp, a \$500,000 loan from ACOA, and a \$1.5 million loan from the Province of Nova Scotia. It was also a winner of Innovacorp’s I-3 competition. In 2016, Cellufuel received \$2.7 million from the federal government’s Sustainable Development Technology Canada fund. Major private sector investors include Quebec-based renewable energy leader Boralex, and the Ontario-based Tatro Group.</p>	
<p>Sustane The winner of Innovacorp’s 2016 I-3 Technology Startup Competition was not a tech company founded by young programmers, but a Chester-based company that aims to reduce waste going into landfills. Sustane Technologies Inc., founded by industry veteran Peter Vinall, has developed technology that allows solid waste destined for landfills to be made into clean and valuable products such as fuel pellets. The system lowers contamination by plastics to a negligible 0.1 percent. Having won \$225,000 through the I-3 competition, Sustane now plans to build its first facility near the Chester landfill at Kaizer Meadow, which will divert more than 90 per cent of material away from the landfill. Vinall, who has worked around the world in the bio-energy and pulp and paper industries, says it is the first technology that can take raw garbage destined for landfill and separate it into clean products.</p>	

Bioenergy

Bioenergy, and in particular biofuels, is a significant opportunity in rural parts of Atlantic Canada. There are companies working on biofuels using a wide range of locally-available feedstocks including wood processing wastes, agricultural wastes, marine sources (e.g., seaweed) and purpose-cultivated energy crops (Box 4J). Many of these initiatives are at the pilot and demonstration phase and will require significant R&D to develop a viable bioenergy industry that complements, and does not compete with, existing industries such as production of

affordable food. Properly encouraged and managed, these opportunities can help grow a sustainable industry that can bring new prosperity and export opportunities to rural economies.

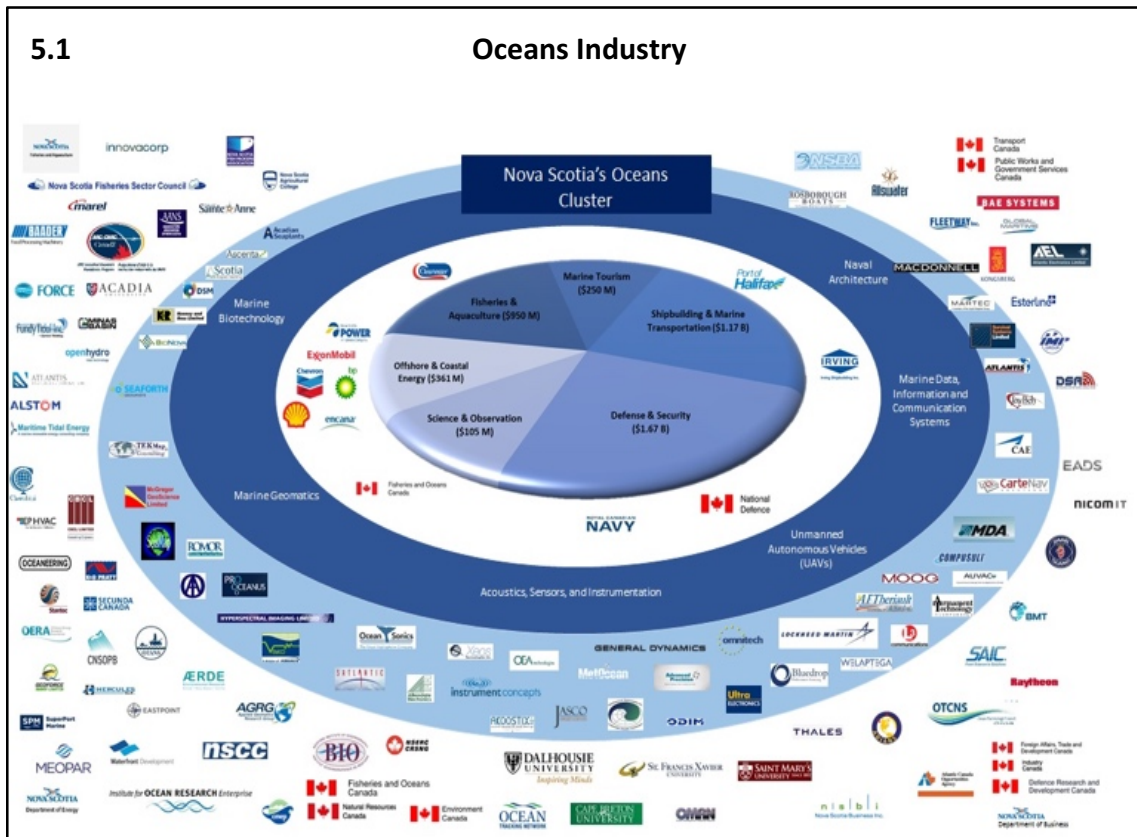
4.5 Recommendation on an Atlantic Cleantech Strategy

In the context of the Atlantic Growth Strategy, the federal and provincial governments should commit to a multi-year cleantech strategy that would support implementation in Atlantic Canada of the new federal climate change framework. The strategy, supported by dedicated funding from the federal government, would aim to develop cleantech research strengths into export opportunities in areas that have strong commercial promise, including smart grid, energy storage, tidal power, and bioenergy. As a first step, the post-secondary institutions should be asked to strike a group with representatives of industry (including the electric utilities in the four provinces) and relevant government agencies, to develop a 5-year plan for submission via ACOA to the federal government.

Chapter 5 DEVELOPING A WORLD-CLASS OCEANS INNOVATION CLUSTER

“We know more about the surface of the Moon and about Mars than we do about [the deep sea floor], despite the fact that we have yet to extract a gram of food, a breath of oxygen or a drop of water from those bodies.”
 —Paul Snelgrove, Oceanographer, Memorial University

Nova Scotia’s history and development are inextricably linked to the ocean; an indefinitely sustainable comparative advantage based on Nova Scotia’s location and a coastline as long as the distance across Canada. Ocean-related activities—the fishery, defence and security, shipbuilding, marine transportation, offshore energy, tourism, and a thriving group of ocean technology companies—comprise a significant portion of the province’s economy, accounting directly for some 35,000 jobs³³. Nova Scotia is home to a strong cluster of oceans industries and to world-class oceans research capabilities (Figure 5.1). The province is therefore becoming a globally-recognized hub of oceans expertise with the potential to be a significant contributor to a number of international value chains related to leading-edge oceans technology.



³³ It is estimated that when spin-off activity is included, the ocean economy in Nova Scotia contributes about 12 per cent of GDP and more than 63,000 jobs—*Economic Value of the Ocean Sector in Nova Scotia: 2007-2011*, prepared for Nova Scotia Department of Economic and Rural Development and Tourism by Gardner Pinfold, March 2014 (The 2014 NS Ocean Study).

This chapter begins with a discussion of the concept and economic significance of an innovation “cluster” and identifies key elements of the oceans cluster centred in Halifax, but part of an Atlantic region super-cluster along the east coast from St. John’s to south of Boston. Three specific recommendations are proposed to help establish Nova Scotia’s oceans innovation cluster among the top centres in the world: (i) seize the opportunity created by the multi-billion dollar naval ships contract; (ii) maximize the contribution to the cluster of the newly-created Centre for Ocean Ventures and Entrepreneurship (COVE); and (iii) establish environmental sustainability as a research and commercial theme of the oceans innovation cluster.

The Cluster Concept

The federal government’s innovation agenda includes a new focus on the support of “clusters” of innovative activity that are judged to have the best potential for strong growth in the future—e.g., the Kitchener-Waterloo/Toronto corridor is often cited as an example of a high-potential cluster in the ICT sector. So what is a cluster, and what is its special economic significance?

A cluster is a geographically concentrated collection of related activities—think, for example, of the film industry cluster that is Hollywood, or of Silicon Valley as the contemporary cradle of information technology, or Canada’s auto manufacturing cluster in southern Ontario. The economic significance of a cluster derives from the many benefits of physical proximity. These include, for example, ready access to specialized services and infrastructure; a concentration of talent; a wealth of opportunities for informal contact that greatly facilitates the identification and evaluation of business ideas and of potential hires; the casual exchange of information and experience among networks of “insiders”. These characteristics of physical closeness mean that the whole is greater than the sum of the parts and that a cluster, once germinated, is self-reinforcing. The greater the concentration, the greater the benefit up to a point where congestion costs (e.g., due to traffic and real estate prices) finally dominate, as appears to be happening now in Silicon Valley.

It is impossible to draw sharp boundaries around a cluster. The benefits of proximity fall off with distance from the centre but do not disappear abruptly. While the Internet means that some of the interpersonal communications benefits of a cluster can now be extended globally, the fact is that *easy* face-to-face contact still matters hugely because so many economic activities take place in physical space. To take just one example, consider the search for talent. Within a cluster, people can be identified and evaluated based on informal word of mouth and casual contact; and if selected, usually do not have to sell their house and uproot their family. So inside a cluster, the market for talent is incredibly efficient, and the denser the cluster, the more efficient. Clusters are therefore powerful generators of innovation and growth, as the history of cities demonstrates.

The cluster phenomenon, at various scales, is ubiquitous. So there is a tendency to define any concentration of a particular activity as at least a potential cluster to be supported with public

policy measures. This understandable political temptation to spread cluster support too widely and thinly must be resisted. Experience from around the world shows that investment, both public and private, needs to be focused where the cluster dynamic is already well-established since that is a sure signal that the conditions favouring strong growth already exist.

5A Halifax-based Elements of North America’s East Coast Oceans Super-Cluster

Halifax is at the core of a “cluster” of oceans-related economic activities that benefit from close physical proximity. This concentration facilitates access to services, common infrastructure, and specialized skills and attracts talent and investment in a self-reinforcing growth process. Among key elements of the oceans cluster are the following.

- *Leading oceans research capabilities:* Dalhousie University and five federal labs in oceans related science and observation provide one of North America’s highest concentrations of oceans research capacity.
- *Thriving ocean technology sector:* Centred in Halifax and focused on sensors, big data, robotics and life sciences—comprises about 60 knowledge-intensive companies, mostly small to medium-sized but also including multinationals, that develop sophisticated products for global markets.
- *Marine transport hub:* The Port of Halifax ranks third in Canada in container tonnage and is well-positioned both nationally and globally.
- *Offshore energy research and staging:* The provincial government’s Offshore Growth Strategy and Play Fairway Analysis (PFA) provided the oil and gas industry with geoscience research and analysis, resulting in Shell and BP committing to spend approximately \$1 billion each on exploration by 2020 despite currently depressed hydrocarbon prices.
- *Defence and security platform:* Halifax is the headquarters, main base, and R&D centre of the Canadian navy on the east coast.
- *Canada’s leader in naval shipbuilding:* Irving Shipbuilding’s \$25-billion naval defence contract will bring 30 years of activity to the Halifax Shipyard, plus anticipated maintenance and up-grading activity that would carry on indefinitely—providing one of Nova Scotia’s most significant economic opportunities with an emphasis on technology and advanced manufacturing.

These activity centres are supported by specialized professional services in finance, law, engineering, logistics and consulting; essential elements that bind the nodes of the cluster into an ecosystem. Although the oceans cluster is centred in Halifax, it connects with and enriches a dense web of oceans activities throughout the province and Atlantic Canada, and complements a second cluster in St. John’s which is focused on cold ocean science and engineering and offshore hydrocarbon production. It is also a key part of the “Oceans Super-Cluster” in Atlantic Canada and New England.

It is likely that only a very limited number of clusters in Canada will receive the bulk of federal support earmarked for innovation clusters, which is anticipated to be about \$800 million over the next four years. There is a strong case to be made that the oceans technology cluster, with poles in Halifax and St. John’s, should be included in that limited number. In fact the Atlantic Canada oceans innovation cluster is part of an east coast “super cluster” that includes an agglomeration of world-class research facilities and ocean tech companies along the New England coast to south of Boston. Proximity to that rich source of capabilities is a significant advantage for the Atlantic Canadian cluster, but to derive the full benefit, Canada’s contribution to the super cluster needs to be upgraded to more nearly match the depth and capability of the U.S. component. Fortunately, Halifax already has an exceptionally broad and deep base in ocean

research and industry and is positioned—thanks to the naval ships contract, and the recent investments in COVE, and the Ocean Frontier Institute—to become a genuinely world-class centre of ocean innovation, but only if the recent momentum is sustained (Box 5A).

5B**Dalhousie University: A Leader in Ocean Research**

Dalhousie is among Canada’s strongest ocean research universities based on academic publications, citations and federal research funding. Its ocean research strength extends across the faculties of science, law, agriculture, engineering, computer science and business with more than 100 researchers focused on oceans related topics. The university has allocated 17 Canada Research Chairs in oceans-related research, including a prestigious Canada Excellence Research Chair. Dalhousie is a member of several international ocean research collaborations; for example: the Helmholtz-Canada Cooperation Agreement with Germany; the Australian Canadian Oceans Research Network; the Global Partnership for Oceans; and the IUCN World Commission on Environmental Law, Specialist Group on Oceans, Coasts and Coral Reefs. Dalhousie is home to several of the leading ocean research initiatives in Canada and indeed globally:

- *Ocean Tracking Network (OTN)* is a 16-country consortium of marine biologists and oceanographers that is building a global underwater array of acoustic receivers to track the global migration of hundreds of thousands of marine animals.
- *Marine Environmental Observation, Prediction and Response (MEOPAR)* is a pan-Canadian network of academic researchers exploring changes in the marine environment and developing better ways to predict and respond to changes in the ocean, at all time scales from imminent to long-term.
- *Canada Excellence Research Chair (CERC)* in ocean science and technology is one of fewer than 20 CERCs across Canada in all fields of science. It is held by Dr. Doug Wallace, one of the world’s leading experts on the exchange of carbon between the ocean and the atmosphere; a key mechanism in the regulation of greenhouse gases.
- *Institute for Big Data Analytics* creates knowledge and expertise in the field of by facilitating fundamental, interdisciplinary and collaborative research, advanced applications, advanced training and partnerships with industry which in Nova Scotia has a strength in data analytics applied to the ocean.
- *Ocean Frontier Institute (OFI)*, a new \$200 million+ investment in ocean science excellence, is a collaborative initiative in which Dalhousie has teamed with Memorial University and the UPEI and several pre-eminent international partners including the Woods Hole Oceanographic Institution, Columbia University, and GEOMAR in Germany. Dalhousie was recently awarded \$94 million to support OFI in the federal Canada First Research Excellence Fund (CFREF) competition. This is in addition to a \$25 million contribution from John Risley, the largest private donation to oceans research in Canadian history. The OFI is positioned to become a globally recognized “think tank of the oceans” exploring large scale changes in the ocean and how these will impact human activity.

Leveraging the Growth of Nova Scotia’s Oceans Innovation Cluster

Previous chapters of this report have recommended measures in the broad context of an innovation strategy that will also be effective in fostering the development of the oceans cluster—for example: programs to build human resources from grade school forward; investment in research excellence in all post-secondary institutions; measures that will create fertile conditions for the growth of innovative startups; programs to enhance the ambition and capabilities of exporters. All of these will promote an innovative oceans cluster. But more focus is required to ensure that Nova Scotia’s *unique* oceans opportunity receives the policy attention and investment that is needed to warrant inclusion among the limited number of major

innovation clusters in Canada. Two specific opportunities stand out: (i) maximizing the benefit of the naval ships contract; and (ii) ensuring that the COVE facility anchors the development of a world-class ocean innovation ecosystem.

The Naval Ships Contract and the ITB/VP Policy

Irving Shipbuilding’s contract to replace much of Canada’s naval fleet—and specifically the “Canadian Surface Combatants”—is presently estimated to have a value of at least \$25 billion to be spread over some 30 years³⁴. The government hopes that this massive procurement can not only provide the Canadian Forces with first-class naval capability but can also be designed to increase the global competitiveness of Canadian industry.

The key policy innovation in this regard is the combination of an Industrial and Technological Benefits (ITB) requirement with a novel Value Proposition (VP). The ITB is essentially a rechristening of the long-standing Industrial and Regional Benefits (IRB) “offsets” policy that requires the winners of defence contracts to undertake business activities in Canada equal to the value of the contract (i.e. an estimated \$25 billion in the case of the naval procurement). These activities do not have to be directly related to the contract in question—though typically a substantial portion would be—and at least 15% of the activity must be with SMEs.

The Value Proposition is an entirely new and significant feature of Canadian defence contracting. For all contracts above a certain size (usually over \$100 million), competing bidders must include a Value Proposition in their bid. The VP, which will typically count for 10% to 15% of the points awarded when the government assesses the relative merits of bids, must describe the bidder’s commitment to undertake certain specified types of activity in Canada—specifically: supplier development; advanced manufacturing; building Canadian export capacity; and R&D (including collaboratively with post-secondary institutions). The objective is to strengthen the competitiveness of Canadian industry, including the bidder’s own Canadian-based activities. Since the VP will count in bid scoring, the bidding companies will have a strong incentive to come up with credible and ambitious commitments to employ their ITB spending in ways that will build Canadian competitiveness in technology-intensive activities³⁵.

The VP and ITB obligations can be fulfilled anywhere in Canada. There is no preference for Atlantic Canada or for Nova Scotia. Still, the fact that (i) the contracts are in the naval domain; (ii) Nova Scotia industry and research institutions have many capabilities relevant to companies

³⁴ Most observers believe that the cost of the number of vessels presently anticipated would substantially exceed \$25 billion, implying that more funds would eventually have to be budgeted or the number of ships and/or their capabilities would need to be reduced.

³⁵ The new ITB/VP policy promises to be particularly beneficial for Atlantic Canada which, according to the latest estimate from StatsCan, is the location of 17% of Canada’s defence industry activity, a proportion much greater than the Atlantic region’s share of national population or GDP. Of course, the region’s defence suppliers will have to compete on the basis of product cost and quality to attract ITB spending.

that are likely to bid on such contracts; and (iii) the final assembly of the ships will take place in Halifax; means that there is an exceptional opportunity for this contract to provide “fuel” to propel Nova Scotia’s ocean innovation cluster. In addition, while the VP commitments for the naval ships can be in any sector, priority will be given to clean technology, cyber security, and the marine sector. It is a once-in-a-generation opportunity, but it will not be fully achieved without concerted effort and sustained focus by business, research institutions and the Province. So far, the focused effort that is needed has not materialized.

5.1 Recommendation on Mobilizing Nova Scotia’s Oceans Innovation Cluster

Create a small senior group in the Department of Business dedicated *full-time* to promote and coordinate the Province’s support of the “Oceans Innovation Cluster” in Nova Scotia. The role of this oceans cluster “champion” would be to:

- a) Spearhead a coordinated effort with the other Atlantic Provinces to secure for Atlantic Canada a share of the \$800 million of federal support earmarked for “innovation clusters”.
- b) Specifically in the Nova Scotia context, work with businesses and the federal government to maximize the benefit of the naval ships contract flowing from the federal Industrial and Technological Benefits/Value Proposition (ITB/VP) policy.
- c) Provide Provincial assistance as required to maximize federal support to the Oceans Innovation Cluster through such programs as the Canadian Accelerator and Incubator Program (CAIP), Centres of Excellence for Commercialization and Research (CECR), Business-Led Networks of Centres of Excellence (BL-NCE), Atlantic Innovation Fund (AIF), Mitacs. Collaborate with the proposed Research Nova Scotia organization regarding the specific research aspects of these programs.
- d) Foster closer relationships among federal oceans-related research facilities (e.g., DFO, NRC, DRDC), oceans-related businesses, and post-secondary institutions.
- e) Serve as the intra-government champion of the Oceans Innovation Cluster and ensure coordination of various supporting initiatives across the Government of Nova Scotia. A first priority in this regard should be to ensure that COVE is properly launched.

To assist in fulfillment of its role, the oceans cluster champion should create an external advisory group with representation from the key post-secondary institutions, industry, the Halifax Regional Municipality, and the other Atlantic Provinces.

Anchoring the Oceans Innovation Ecosystem—The Centre for Ocean Ventures & Entrepreneurship (COVE)

The second key opportunity to take Nova Scotia’s ocean innovation cluster to the next level has arisen as a result of the creation of COVE. This facility will occupy the former Coast Guard station on the Dartmouth side of Halifax harbour. When renovated by mid-2018, it will anchor an innovation ecosystem bringing together oceans researchers, incubator space for startups, shared equipment and facilities for SMEs, office space for major companies, and deep water

access for research projects and vessels. Located right in the centre of a major metro area, COVE is precisely the kind of initiative that can energize an oceans innovation cluster and drive ocean technology commercialization, startups and scale-ups (Box 5C).

Now that nearly \$20 million has been committed by the Province and the federal government for renovation, the next step is to establish a management and governance structure and to secure operating funds for at least a startup period of, say, five years. It is important to distinguish between COVE as a *physical* facility with costs and revenues that relate directly to service provision; and COVE as an *organizational* entity that not only manages the physical aspect but also gives the initiative identity and strategic intent. Ultimately, the physical entity may be close to self-supporting from tenant rental and memberships, and eventually from project work. The immediate challenge is to secure funding for COVE as manager and strategic nerve centre—the enabler of the whole enterprise as well as the catalyst and connective tissue of the ocean innovation cluster. These functions are all “public goods” which are currently being insufficiently supplied. They also have substantial costs which are often unacknowledged; but are necessary for the growth of the cluster. For this purpose, funding will be required from one or more industry partners, but also from government.

Industry support might come through an ITB/VP commitment related to the naval ships contract on the grounds that COVE will be a key agent of marine sector innovation, including R&D, supplier development, and export readiness—all activities that earn points in the evaluation of Value Propositions. Federal support might be obtained, for example, if COVE were able to qualify, through a competition, as a Centre of Excellence for Commercialization and Research (CECR). On the provincial side, Innovacorp and NSBI will have roles to play, respectively, in startup incubation and investment attraction. But who has a mandate to support COVE, the organizational entity, without which the performance of the whole enterprise will degrade or collapse? The Province needs to ensure that such does not become the fate of COVE. This will require, on an urgent basis, proactive engagement to secure industry and federal support and a willingness to be a backstop and kick-start the cluster, while continuing to play a funding role thereafter.

In some respects, COVE will play a role in the oceans innovation cluster analogous to the function of the Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ) in the Montreal aerospace cluster, though the parallel cannot be exact given the very different contexts of the two industries. COVE would promote collaboration between industry and research specialists to identify and implement precompetitive projects that meet industry requirements in ocean technology while leveraging respective resources to support projects and activities on a larger scale. For example, this could provide funding for research consortia related to ocean technology with a focus on sensors, robotics and autonomous underwater vehicles (AUVs), artificial intelligence, and big data to spur business innovation through collaborative ocean

technology R&D, with applications for the economy, science, surveillance, and environmental response. A particularly important CRIAQ program supports the acceleration of innovation by SMEs. Such a collaborative industry-led applied research consortium in ocean technology could leverage federal funding programs such as CECR and Business-led NCE.

5C Centre for Ocean Ventures & Entrepreneurship (COVE)

COVE is an ocean technology incubator and accelerator that will be an anchor facility for Nova Scotia's oceans innovation cluster. The ultimate objective is to increase the rate of formation and success of new ventures, to enhance the growth of existing ocean companies, to increase university research commercialization, and to attract foreign direct investment in the ocean sector. COVE will anchor an Atlantic Canadian community of entrepreneurs, startups, SMEs, large companies, research institutions, and enabling organizations in the oceans innovation ecosystem.

COVE will occupy an 8-acre site with substantially renovated space in the former Coast Guard facility on the Dartmouth side of Halifax harbour. The renovation, which is slated for completion in the first half of 2018, will include approximately 50,000 sq.ft. of covered space within existing buildings and is supported by a grant of \$19.7 million, of which \$12 million is being provided by the Province and \$7.7 million by Canada. Three Provincial crown corporations will have on-going roles: Waterfront Development Corporation as landlord; Innovacorp for incubator facilities, and NSBI for marketing and investment attraction. An overarching management and governance structure is still to be determined. The existing Institute for Ocean Research Enterprise (IORE) has played a leading role in the conceptual development of COVE and might be re-mandated to provide the management function. Operational funding for the facility will come from tenant rentals, membership fees, project income, one or more large industry partners (perhaps to fulfill ITB and Value Proposition commitments), and from a variety of government sources including potentially as a CECR.

COVE will operate as a mixed use marine facility. Ocean researchers at Dalhousie and other academic institutions will benefit from exposure to working ocean businesses. Startups and SMEs will gain early access to leading ocean research and to contacts with large ocean industry actors to help with developing scalable product ideas and market access. Large ocean industry tenants will gain access to agile innovators both in academia and in small businesses. For traditional ocean industry players COVE will create the opportunity to fundamentally transform their businesses through use of innovative technology. Larger ocean systems companies (e.g., IBM, Lockheed-Martin, Shell) will be motivated to participate by virtue of their obligations to various levels of government including ITBs for aerospace and defence companies and R&D investment commitments under royalty agreements for oil and gas companies. The interaction among these diverse groups will be a key value of COVE. It will be a condition of tenancy that each resident commit to open engagement with other tenants regarding research and commercialization opportunities. Such a requirement reflects the experience of Iceland's Ocean Cluster organization which has reached out to establish collegial relations with counterparts in Portland, ME and Gloucester, MA. COVE should become a member of this transnational "club".

While COVE will have an iconic physical presence on Halifax harbour, its programming impact will be designed to extend across the region and internationally. Programs will be designed to support both full-time residents as well as virtual members. Video conferencing and regular visits by COVE staff to other parts of the region will ensure that the facility has value to the entire province of Nova Scotia and well beyond. Further solidifying the reputation of Nova Scotia's ocean technology cluster, COVE will establish a network of affiliations with leading clusters globally, initially in New England, California and Western Europe.

5.2 Recommendation on the Centre for Ocean Ventures & Entrepreneurship (COVE)

To ensure that COVE is able to fulfill its role as an anchor institution of Nova Scotia’s Oceans Innovation Cluster, the Province should:

- a) On an urgent basis, work with stakeholders—including, but not limited to, provincial crown agencies and the Institute for Ocean Research Enterprise (IORE)—to establish a governance and management structure for COVE that provides sufficient budget and independence for COVE to operate as a private sector organization.
- b) Assist COVE to secure operating support from federal funds earmarked for support of innovation clusters as well as programs that support incubators and accelerators.
- c) Leverage federal funding programs for research and commercialization to support creation at COVE of an industry-led applied research consortium in ocean technology for Atlantic Canada. This could draw on the experience and programs of CRIAQ, a successful Quebec-based consortium in aerospace.
- d) Provide all appropriate support to COVE’s efforts to secure funding from one or more large industrial partners in the context of the ITB/VP policy or otherwise.
- e) Make available immediately adequate bridge funding (e.g., \$1 to \$2 million per year) to support COVE’s management functions until longer term funding is secured; then a reduced amount once other federal and industry contributions are secured.

The Contribution of Ocean Innovation to Environmental Sustainability

Oceans cover 70% of the planet’s surface. It is only because we are largely unaware of this vast aquatic environment that we fail to recognize, for example, the pivotal role played by oceans in climate change—the oceans are an enormous heat sink and absorber of CO₂—and the complexity of the ecosystems below the waves. Thanks to new observational technologies, many of which are being developed in Atlantic Canada, the ocean environment is slowly becoming more “transparent,” thus opening vast new pathways for research to understand the planet’s last great frontier. The new Ocean Frontier Institute and many other research initiatives throughout Atlantic Canada will be at the forefront of this endeavor (Box 5B). With new understanding will inevitably come new human uses for the ocean and its web of life. Fortunately, these possibilities are emerging at a time of growing awareness of human environmental impact. Sustainability has become the watchword of our era. It must therefore be a prominent theme of the oceans cluster in Atlantic Canada. Two examples – the commercial fishery and offshore aquaculture—will illustrate.

The commercial fishery in Nova Scotia, though too often regarded as a traditional industry with a limited future, has benefited from a number of innovative initiatives, by both SMEs and large companies, to dramatically improve productivity, develop new products, and open markets all over the world. A number of highly entrepreneurial business people have shown the way to much greater value added and strong export growth in a traditional, rural-based sector. These successes

only underline what is still to be achieved if the rest of the industry embraces innovation. Two outstanding examples—Louisbourg Seafoods and Clearwater Seafoods—are described in Boxes 5D and 5E.

5D

Louisbourg Seafoods

When the cod fishery was collapsing in the 1980s, Lori and Jim Kennedy determined not to waste a crisis. They became entrepreneurs and started Louisbourg Seafoods, which now boasts several fish plants, 13 fishing vessels and 500 employees. Louisbourg Seafoods has always been investing in equipment to produce a higher quality product while reducing impact on the ocean ecosystem by minimizing by-catch and discard mortality. As members of the World Ocean Council, the company promotes innovation to ensure traceable, and sustainable products. The commitment to quality and innovation has made Louisbourg an export phenomenon. When the U.S. economy was hit by the 2008 recession, the company doubled down on innovation, invested in new equipment, increased productivity and diversified its markets into Europe and Asia. Louisbourg invests in young talent, and gives them the room to innovate. Employees like Adam Mugridge and Glen Fewer, who graduated from Dalhousie's marine biology program, have helped the company recently expand into aquaculture; create a startup looking at the innovative use of traditional processing waste by-products based on a multi-year research partnership with CBU; and form a company involved in the production of marine plants for agriculture and cosmetic products (Natural Ocean Products, a winner of Innovacorp's I-3 startup competition in 2013). The federal Build in Canada Innovation Program became a first customer for their new liquid seaweed fertilizer product.

Louisbourg's commitment to innovation is reflected in a recent experiment with the greater Sydney tech community. The company began to work with the programmers and startup enthusiasts on a collaboration that led to the Sea++ Competition, in which Louisbourg Seafoods offered a first prize of \$5,000. There were positive benefits beyond the competition itself. Louisbourg Seafoods hired several of the participants, and having seen the talent available among the Island's youth, and the ideas generated during Sea++, several new projects have been developed. One addresses data collection and analytics associated with Louisbourg Seafoods' aquaculture operation, another is introducing a new IT system to support the company's supply and logistics operations. Louisbourg staff involved in the competition point to the knowledge mobilization associated with leveraging the talents of young Cape Bretoners and giving them a reason to stay on the Island. The Sea++ competition underscores the importance of the growing technology hub in Cape Breton and how innovative technologies can address the needs of a company in a resource sector that is a mainstay of Nova Scotia's rural communities and a significant contributor to export excellence.

Our commercial fishery resources must of course be harvested sustainably and that has long been a core objective of DFO's stock assessment science, but much still remains to be understood about the complex, interacting ecosystems that are involved. Ottawa's new commitment to revitalize government science is welcome and should open up new opportunities for collaboration between DFO and universities and ocean technology companies in Atlantic Canada. Nova Scotia's ocean technology expertise in sensors, robotics, AUVs, coupled with the advanced data analytics strengths at several universities in the province, create significant opportunities to understand the continually evolving environmental and sustainability implications of the commercial fishery. At the same time, the development of more innovative and sustainable harvesting methods is a constant challenge to innovation, requiring design of

catching technology that has less impact on seabed habitat, is more species-selective, and operates more energy efficiently. As one of the world's leading fisheries economies, Atlantic Canada should be doing a great deal more to develop and market innovative technological solutions to these sustainability challenges.

5E

Clearwater Seafoods

Is Clearwater a technology company? For a business that sold more than half a billion dollars of seafood in 2015, this seems like an odd question. But technology is core to everything they do.

Clearwater Seafoods is the largest holder of licenses and quotas for shellfish in Canada, and one of the most innovative players in the fisheries sector in the world. A vertically integrated firm, Clearwater operates processing plants throughout Atlantic Canada, and manages a logistics and distribution network which touches forty countries. Clearwater has always been international and forward-thinking: from the entrepreneurial spirit of John Risley and Colin MacDonald driving lobsters to Boston when they started the company in 1976; to shipping lobsters live to Europe in the 1980s; to today, where nearly all of its revenues come from export markets. Early on, Clearwater's managers recognized the promise of export markets and put in place the technology and systems to ensure the freshest possible delivery. Clearwater helped to popularize surf clams in Japan, and developed technology by which they could be shipped cheaply from Newfoundland to East Asia without sacrificing quality or volume. Clearwater has developed new end-user products (such as packaged bacon-wrapped scallops) and has found a practical way to "brand" a live lobster using a special logoed sleeve that fits over a claw. Recently, Clearwater has gained sufficient reputation and trust in the Chinese market that it has begun to sell directly to Chinese supermarkets rather than just through wholesalers and the hospitality industry.

A technology innovator, Clearwater uses automated shucking machines which are twice as efficient at harvesting scallops as previous methods. It is becoming a big data leader, gathering sonar data on the environment and harvesting which can enhance long-term productivity *and* sustainability. Technology helps Clearwater lower costs, reduce environmental impacts, and become an even more sustainable company – because, after all, their business depends on a renewable resource.

A second example where sustainability and economic opportunity intersect in an oceans context is the case of deep ocean aquaculture, currently being pioneered by Nova Scotia entrepreneur, Robert Orr (Box 5F). This technologically demanding initiative could eventually yield a vast new food source to meet a rising global demand for high-quality animal protein that is facing a relatively static supply of sustainable sources on land and of wild fish stocks. Offshore aquaculture could provide a sustainable solution although there are many biological, engineering and economic issues that will only be resolved through innovation informed by research and development.

5F

Cuna del Mar: A Global Pioneer in Ocean Aquaculture

With the rise of a global middle class as the emerging economies become more affluent, traditional sources of protein are reaching, or have already reached, their sustainable limits. That is why the global demand for aquaculture is poised to increase significantly. In fact, almost half of human seafood consumption is already farm-raised. An emerging frontier technology is *offshore* aquaculture. Deep ocean aquaculture sites have advantages in scale and sustainability, but face significant process technology challenges that will create opportunity in the form of new demand for ocean sensors, marine robotics, heavy engineering and data. Large-scale offshore aquaculture would thus draw on Newfoundland’s ocean engineering expertise; Nova Scotia’s expertise in sensors, robotics and big data; and the marine bio-science expertise throughout Atlantic Canada.

Cuna del Mar is a private equity firm managed by Nova Scotia entrepreneur, Robert Orr. The company provides financing, governance, and advisory services to innovative ocean aquaculture companies that are environmentally and socially responsible. Its focus is on offshore aquaculture well removed from sensitive inshore and inland areas. Cuna del Mar’s portfolio companies (which includes Open Blue, operator of the world’s largest deep water open ocean aquaculture farm off Panama) are shifting aquaculture practices in a more efficient and sustainable direction by pioneering new production techniques and by reviving potentially profitable species. Offshore aquaculture is an industry still in the R&D stage but with potential to have an enormous impact on healthy, sustainable food production.

5.3 Recommendation on Sustainability and the Oceans Innovation Cluster

“Sustainability” should become a strength of Atlantic Canada’s Ocean Innovation Cluster and a motivation for both research and technological innovation. To this end:

- a) COVE’s new management should lead a collaboration with representation from industry, relevant federal departments, and the Ocean Frontier Institute to develop a roadmap of areas where sustainability objectives intersect with research and commercial capabilities that are resident in the region, including sensors, robotics, AUVs, and advanced analytics.
- b) Based on this assessment, the federal government should allocate a portion of the \$800 million budget earmarked to support innovation clusters to create an “Ocean Sustainability Innovation Fund” that would support, on a competitive basis, projects that demonstrate innovative approaches to oceans-related sustainability issues.
- c) To encourage further development of projects that demonstrate good commercial potential, the government should permit under the ITB rules a “multiplier” for ITB expenditure related to projects that have been selected for funding under the competitive process recommended in (b) above.

Chapter 6 KEEPING GOVERNMENT FOCUSED ON INNOVATION

“It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change” — Charles Darwin

The innovation strategy detailed in previous chapters includes recommendations in respect of the *enabling* role of government; primarily through policy, programs, and investment. But the strategy, to this point, has not addressed innovation within the public sector itself. This is a significant omission since the government of Nova Scotia is by far the largest single entity in the economy, accounting for more than \$9 billion of program spending and employing tens of thousands of Nova Scotians either directly or in funded activities such as health care and basic education. This final chapter therefore addresses the innovation challenge facing the public sector with several examples that illustrate the opportunity to do better. But these only scratch the surface.

The chapter concludes with a key recommendation—arguably the most important in the report—that the Province assign a clearly identified centre of day-to-day responsibility to *champion* the action agenda that has been proposed. Decades of experience demonstrate beyond a doubt that external advice lands with a thud on the desks of public service managers who are constantly under the gun to deliver on existing, well-established responsibilities. Without leadership to set new priorities and new accountabilities, the press of “business as usual” relegates every report like this to the proverbial dusty shelf. Will this time be different?

Enabling Innovation in the Government of Nova Scotia

Governments, by nature, are not very innovative. There are some good reasons why that is usually the case. In the first place, all big organizations, from banks to armies to multinational corporations, have to operate within formalized rules in order to keep a large number of individuals and processes aligned toward common objectives.³⁶ The disruption of innovation is usually counterproductive, at least in the short run. Conservatism is therefore inbred in the bureaucratic DNA. In the special case of government, where screw-ups get all the press, every failure is particularly heavily penalized. But innovation is risky by its very nature and, in the glare of the media or the scold of the opposition critic, the risk is usually perceived to exceed the reward. On the other hand, the public rails against the presumed “waste and inefficiency” and indifferent service of government, and resists any tax increase. So there is, after all, a reward for

³⁶ That is why, as Dilbert says, “Large corporations welcome innovation and individualism in the same way the dinosaurs welcomed large meteors.”

a government that commits to finding new or better ways of doing things—that is, for a government that innovates.

The prevailing balance of incentives inside government is nevertheless heavily tilted toward the tried and true of the status quo. That is why innovation rarely emerges without strong and sustained leadership encouragement and reward. This can arise naturally in isolated cases, thanks usually to the creative spirit of an individual manager or small group. For an example close to home, consider the story of the winner of the Gold Award for Innovative Management from the Institute of Public Administration of Canada (Box 6A). While inspiring examples like this prove that innovation in government *is* possible, unfortunately they are too much the exception.

6A Innovation in Government – The Nova Scotia Trunk Mobile Radio Initiative

In 2016, the Nova Scotia Department of Internal Services, Public Safety and Field Communications received the Gold Award for Innovative Management from the Institute of Public Administration of Canada for the “Trunk Mobile Radio Initiative” (TMRI). The prestigious award is given annually to government organizations that have demonstrated exceptional innovation. The TMRI created the most interoperable public safety radio communications system in North America, connecting government, non-profit, and private partners across multiple jurisdictions, enabling them to communicate effectively to provide emergency services. In Nova Scotia, the new system supports all police, fire, EMS, Search and Rescue, municipal EMO, 14 provincial departments and, four federal departments, servicing approximately 20,000 users across 80 organizations and sectors. More recently, it has spread to other parts of the Maritimes, making it the first multi-province/state system in North America. The TMRI shows that when faced with a challenge, and provided with the freedom and resources necessary to find solutions, public servants have what it takes to come up with world-class innovation.

A *systematic* approach to innovation in government must respect the very real constraints identified earlier. Wholesale changes rarely, if ever, work. They are like trying to change a tire on a moving car. More realistic is to introduce an innovation on a smallish scale (a pilot) so that its effect can be isolated and its practical advantage demonstrated. Then, like any innovation, its impact will depend on the extent of diffusion and uptake. Both the pilot and the uptake need to be strongly encouraged from the top to overcome inbred resistance. But if government is going to goad business in Nova Scotia to be more innovative, as indeed it should, government should be prepared to take more of its own advice. After all, it is the elephant in the room.

What follows is a brief and somewhat speculative introduction to some prominent areas of opportunity for innovation in a public service context—specifically related to healthcare, “digital government”, and social innovation.

Innovation in the delivery of healthcare

Nova Scotia's ageing population and resultant high level of chronic disease is creating a growing strain on the healthcare system and on the \$4.5 billion budget that sustains it. We can see where business-as-usual is leading and it is not where Nova Scotia can afford to be. Healthcare represents, therefore, the greatest single opportunity for innovative impact among all services delivered by the Province. Innovation holds forth the tantalizing win-win prospect of better patient outcomes at lower cost, leading to healthier people, living and working longer. It is important nevertheless to acknowledge just how large, complex and interconnected the healthcare system is. Experience in Canada and abroad has shown that there are no easy fixes and certainly no "silver bullets". That is why a healthcare innovation strategy must balance ambition with pragmatism. But unless you start you will never finish.

OPOR and a laboratory for e-health and m-health

The most fundamental place to start is with the electronic medical record, which makes patient information instantly accessible and portable. Nova Scotia is pursuing this approach through a single province-wide electronic medical information system called "One Person, One Record" (OPOR). This has been enabled in principle with the merger of nine regional health authorities into one – the Nova Scotia Health Authority, as well as the IWK Children's Hospital. Meanwhile, the healthcare industry is on the cusp of a new wave of information technology adoption as comprehensive "digital health" strategies emerge. These leading-edge medical information systems have the potential to be an open-source tool that collects data from healthcare providers and connected devices/monitors to give both providers and patients access over the Internet or by mobile phone. It promises more patient-centric healthcare and will enable mobile health applications that can improve care delivery in rural communities or directly in the home.

By combining OPOR with a strong ICT industry, big data capabilities, and a top-notch medical and clinical research community, Nova Scotia has a realistic opportunity to be a leader in Canada in the use of data, analytics and mobile technology to transform healthcare delivery. The added benefit in so doing would be to create economic opportunities in a vast new digital health industry that is still in its formative stages. More specifically, there is now the chance to exploit a first-mover advantage for Nova Scotia to use its size—not too small to be a test case, and not too large to be stymied by inertia—to be an incubator for healthcare transformation in Canada, which could then be exported. To this end, the Nova Scotia Health Authority, the IWK and Dalhousie Medical School, with support from the provincial Department of Health should create an electronic-health and mobile-health research lab, applied testing program, and accelerator program to develop, test, and implement e-health and m-health solutions. Because projects like OPOR are very expensive and complex, they will not be implemented quickly and therefore neither will the creation of the e-health and m-health research/test facility.

Centre for Innovation in Healthcare Delivery

The Nova Scotia Health Authority, the IWK and Dalhousie Medical School, with support from the provincial Department of Health, should create a multidisciplinary centre for innovation in healthcare delivery. The centre would include not just healthcare professionals, but also relevant professionals like designers, psychologists, social workers, engineers, and data scientists. The Nova Scotia Health Authority could present significant and complex problems to the centre, and teams could work over several months to develop innovative and operationally practical solutions for in-service trial, on a pilot basis, in collaboration with the Nova Scotia Health Authority and one or more participating hospitals.

Extending the TRIC grant model

Government employees need to be encouraged and enabled to apply an innovation lens to their daily work. A proven model already exists in the innovative “Translating Research Into Care” (TRIC) grants introduced in 2013 in the IWK and Capital Health and funded by the IWK and QE II Foundations (Box 6B). The concept should be generalized and adapted for application in provincial service delivery functions, including at least P-12 education, community services, and internal services. The funding support required for these “Innovation Trial Projects” would be very modest relative to the potential benefit, both in improved service and in implanting a culture of managed innovation.

6B	Translating Research Into Care – “TRIC”
<p>In 2013, the IWK Health Centre in Halifax established the “Translating Research Into Care” (TRIC) program. The program, financed by the IWK and QE II Foundations, funds point-of-care research that translates existing research evidence into better service delivery and patient care at the IWK and QEII. Support is offered to projects that improve patient outcomes, reduce wait times, improve access for under-served populations, and reduce costs. Three levels of funding support are available, ranging from \$3,000 to \$60,000. Projects are co-led by researchers and administrators and must include the “patient voice”. Operational costs are not covered and are absorbed by the department. For the first adjudication process in 2013, the IWK Foundation allocated \$308 thousand to 15 of the nearly 40 proposals that were received. The program has already led to improvements in healthcare delivery at the two hospitals. For example; one TRIC grant was used to develop and trial the “iCare Adventure” app on iPad minis, given to children in the emergency waiting room. The app is designed to entertain children with games and activities, while simultaneously sending reminders to children with dehydration symptoms to drink their Pedialyte. The app also collects data on the child’s pain level to provide physicians with initial data before they even meet the patient. Other research projects are investigating ways to improve the pre-operative experience of children on the autism spectrum, methods for encouraging children to stay still while receiving MRIs, and the effectiveness of an online communication portal for home-dialysis patients.</p>	

Innovation in “digital government”

Nova Scotia’s Internal Services Department, and particularly the Information and Communications Technology Services (ICTS) branch, are motivated to be innovators in “digital government” to achieve ambitious objectives in respect of both operational efficiency and service quality. A lot could be learned from Estonia, a small Baltic country that is the world leader and pathfinder in digital government (Box 6C). Similar in scale to Nova Scotia, Estonia could be a mentor to help bring the Province to a position of digital government leadership in Canada.

6C	Estonia: The Global Leader in e-Government
<p>Estonians can start a business online in a quarter of an hour, and can file taxes in a matter of minutes by simply checking boxes in a revenue agency web-app. If they so choose, all of their engagements with the State can be paperless — no government agency can legally reject a digitally signed form. Since gaining independence from the Soviet Union, Estonia has built the world’s most technologically innovative public service. The small Baltic state has radically streamlined the delivery of public services, saving civil servants, businesses, and private citizens time and money. At the heart of Estonia’s experiment in e-government is a secure, internet-based data exchange system called X-Road. This is a distributed architecture that connects many discrete databases, allowing information to be shared with ease among government agencies, citizens, and businesses. X-Road also supports the Estonian ID card system, at the heart of which is a unique eID signature which Estonians can use to vote, access government records, and even present in lieu of a driver’s license. This system has been so successful that Tallinn, the capital city, has started an e-Residency program that creates eIDs for foreign nationals in order to improve the ease of doing business in Estonia. Critically, eID holders may also choose which government agencies have access to their information, and what information is shared. Estonia set out to increase national competitiveness by improving the efficiency of public administration. By harnessing existing technologies and applying them in novel ways, a tiny country on the periphery of Europe achieved astounding results.</p>	

An immediate opportunity much closer to home would be to participate in the “Innovation Outposts” initiative recently launched by Volta Labs for large corporate partners (Box 6D). Participating companies locate small teams at Volta to work on “intrapreneurial” innovation and experimentation in a culture that nourishes new ideas. It is based on a similar program at Waterloo’s Communitel which has as clients corporations like General Motors, Canadian Tire, TD Bank Group, Manulife, Canon and Deloitte. Atlantic Lottery Corporation is the first Innovation Outpost at Volta. The provincial government should locate a digital government team at Volta. This could be a three-year partnership, similar to corporate partners, and focused on specific projects. A high priority first candidate would locate a team to focus on simplifying and digitalizing the process for incorporating a business in Nova Scotia, which currently is lagging far behind electronic processes in other provinces, and in this province is archaic, time-consuming and expensive.

6D

Volta Outposts

Volta has partnered with the Atlantic Lottery Corporation to create Atlantic Canada's first "Innovation Outpost", based on the model pioneered by Communitech in Waterloo, Ontario. It is anticipated this program will generate significant innovation applicable to the gaming industry. The partnership and associated programming will set an exemplary standard for solving complex problems from the outside in. The outpost lead is the 'founder' and 'CEO' of a lab that is all about brainstorming, customer discovery, and rapid prototyping. Understanding what customers want and how to engage youth should be top priority before prototyping starts. Volta's educational events and mentorship will guide the team through business model navigation and the steps to build products with strong value propositions. At the end of each week, the lab lead will be encouraged to bounce the newest idea or challenge off the startup founders at Volta, as peer to peer mentorship is key to efficiency.

Social Innovation

Social enterprises and social innovation provide a new mechanism for addressing complex social issues by engaging the private and "third" sectors, to develop solutions that produce better outcomes, potentially with less public funding. To encourage this approach, the Province of Nova Scotia has introduced a social entrepreneurship strategy. To go an important step further, the Province should also engage *directly* in social innovation in the delivery of its own services; for example, through "change labs" and social impact bonds.

Change labs

Change labs represent a new approach to particularly recalcitrant problems that have not yielded to traditional solutions. These could include such tough issues as obesity, sexual violence, racism, mental health, and aboriginal justice. The approach is designed to allow non-traditional solutions to emerge through collaboration. The process begins with defining the full dimensions of the problem by bringing together many different people or groups that have a relationship with the topic at hand but from a wide range of perspectives and experience. Since the process is designed to address the most difficult social challenges, it can take months and even years to address the entire situation. However, through a "rapid prototyping" process, various specific elements of the problem space can be tackled as part of the broader approach. The method is being pioneered in Nova Scotia through the *Change Lab Action Research Institute (CLARI)* located at Saint Mary's. It is a partnership with five other universities—Acadia, Cape Breton, Mount Saint Vincent, St.FX, Université Sainte-Anne, and the NSCC. The provincial and federal governments should engage CLARI directly to tackle some of the most solution-resistant social problems facing Nova Scotia. Provincial staff would participate in the change lab to work with students, researchers, community organizations, and not-for-profits to explore the application of this remarkably innovative approach.

Social finance

Social finance is an approach to mobilizing private capital that delivers a social dividend and an economic return to achieve social and environmental goals. It creates opportunities for investors to finance projects that benefit society and for community organizations to access new sources of funds. Of particular interest are Social Impact Bonds (SIBs), a mechanism that is increasingly being used worldwide to mobilize private capital to tackle complex social challenges. For example, SIBs are currently being used around the world to address issues such as recidivism in the prison system (Peterborough, UK) and at-risk families (Saskatoon, Saskatchewan). A Social Impact Bond is an innovative pay-for-performance approach that brings together government, corporations, private investors, foundations, service providers and social enterprises to create novel, outcomes-oriented interventions to pressing social challenges. Through an SIB, private funds are used to finance investment in social program interventions that are delivered by service providers with a proven track record. Provided that the agreed upon social outcomes and savings to government are achieved, financial returns to investors are paid by government. The SIB mechanism encourages a more outcomes-focused approach in certain social programming contexts since the return to the bond investor depends on the extent to which *measurable* targets are actually achieved. Nova Scotia should pilot one or more social impact bonds to address a social programming area where there has already been experience elsewhere. This evidence-informed approach would be more likely to be credible with potential investors and would improve the odds of an early success to build upon.

6.1 Recommendation on Enabling Innovation in the Government of Nova Scotia

The Province should commit to foster a culture of innovation in public service functions with the goals of stimulating employee creativity, improving service quality, increasing productive efficiency and thereby reducing cost, and creating economic opportunities that inevitably arise from innovative initiative. Early steps to be taken by the government to this end could include the following:

- a) To maximize the economic opportunity created by the pending introduction of the “One Person One Record” electronic health record, create a research lab, applied testing program, and incubator/accelerator facility to develop e-health and mobile-health solutions for the global digital health market.
- b) In collaboration with the Nova Scotia Health Authority, IWK Hospital, and the Dalhousie Medical School, create a multidisciplinary “Centre for Innovation in Healthcare Delivery” to develop innovative approaches to significant care delivery challenges for trial in participating hospitals and health centres throughout the province.
- c) Extend the concept of TRIC (Translating Research Into Care) grants, pioneered at the IWK/QE II hospitals, to other selected provincial services—e.g., P-12 education and community services. Develop protocols and provide funding for “Innovation Trial Projects” to be tested in operating environments.

- d) Mandate the Department of Internal Services to accelerate the implementation of “digital government” services. To this end, seek first-hand advice from successful pioneers like Estonia, and establish an “Innovation Outpost” at Volta Labs.
- e) Experiment with innovative approaches to social programming by, for example, issuing a Social Impact Bond and assigning provincial staff to engage with the new Change Lab Action Research Institute at Saint Mary’s University.

Keeping Focused on the Innovation Strategy

“If you always do what you always did, you will always get what you always got.”

– Albert Einstein

Innovation is never easy. It disrupts “the way we have always done things around here.” Yet as the philosopher, Francis Bacon, wisely observed some 400 years ago: “He who will not adopt new remedies must expect new evils; for *time* is the greatest innovator.” Bacon understood that evolution is the characteristic of all things, so those who stand pat are doomed to be passed by. We know this; yet we resist the innovators among us because it is always easier to put off change until tomorrow. But then “tomorrow” becomes “today” and procrastination reproduces itself. So innovation is held at bay until either some catastrophe imposes change, or the cumulative cost of inaction finally crosses a tipping point where change can no longer be resisted. By then it may be too late, or at the very least, valuable time will have been lost, allowing the innovators, who are quicker off the mark, to seize the day.

As the Ivany Commission warned in its seminal diagnosis of Nova Scotia’s economic prospects—*Now or Never*—the province cannot afford to put off until tomorrow what we know needs to be done today. The Ivany Commission articulated a consensus that Nova Scotia needs to change, and to change is to innovate. Yet experience has shown that the significant changes that are required *will* be put off unless deliberate and forceful steps are taken to transform a habit of reactivity into one of proactivity.

The innovation strategy proposed in this report can ultimately only be implemented by the businesses, the educational and research institutions, the risk investors, and the working people of Nova Scotia. But without the animating force of political leadership there is no reason to believe that the course we have been on will, by itself, change for the better. If it could have, it would have. So the indispensable role of government is to be an *enabler* of the innovation needed for Nova Scotia to change course. Through well-designed policies and programs, government can alter the incentives that arise from the market and from other social and institutional processes—away from incentives that are frustrating innovation and toward those that promote innovation.

Still, for the reasons explained earlier, few institutions are more change-resistant than government itself. So if left alone, advisory reports like this one, and dozens that have gone before, will have little or no influence once the first blush of enthusiasm wears off and everyone goes back to their day jobs. A deliberate step has to be taken to avoid this predictable outcome. This must begin with a clear articulation by the Premier that implementation of an innovation strategy will be the number one economic priority of the government. Then a centre of responsibility must be identified and given the day-by-day task of ensuring that the innovation strategy is in fact implemented. Although the specific measures in the strategy will involve many departments and agencies, overall responsibility to serve as the “champion” rests most naturally with the Department of Business, which was created as a central agency to foster economic growth. In view of the well-recognized tendency for any broad, cross-government initiative to be relegated lower priority in the daily press of urgent matters, *a means must be put in place to sustain focus on the innovation strategy*. This requires that milestones and metrics be established and regularly reported on since “what gets measured is what gets done.” The new “Delivery Unit”, reporting to the Premier, was created for just such a purpose.

The Department of Business, as champion of Nova Scotia’s innovative growth strategy, must be suitably empowered by the Premier and Chief Deputy to fulfill its essential responsibility. To be effective, the Department will need financial resources to “incentivize” certain other departments to undertake initiatives that will contribute to the innovative growth strategy. Long experience with failed coordinating agencies at the federal level in Canada has demonstrated beyond question that without funds to support collaborative initiatives with other key departments, the coordinating function cannot be effective. Put bluntly—money talks. The Department of Business must also be given prominence as a central agency and as the driver of innovation and growth *policies* needed to grow the economy and the tax base to support essential services. Of course, it is the sole responsibility of the Department of Finance and Treasury Board to oversee the provincial budget and program spending. Although there may be some natural tension between the economic roles of the Department of Business and the Department of Finance and Treasury Board in the short-run, they must work together to enable the Province to implement the innovative growth strategy, and thus achieve their common goals in the long-run: fiscal health *and* a more vibrant and prosperous economy.

6.2 Recommendation on Sustaining Government’s Commitment to an Innovation Strategy

To ensure timely and effective implementation of an innovation strategy for Nova Scotia, it must be a clearly articulated priority of the Premier and Cabinet. Responsibility for implementation should rest with the Department of Business. The Economics and Statistics Division of the Finance Department would support data collection and analysis, and the newly-created Delivery Unit would provide assistance, establish milestones and metrics, and report on progress. In its role as “champion” for the innovation strategy, the Department of Business would:

- a) Develop an overall plan to implement Nova Scotia's innovative growth strategy.
- b) Convene cross-department collaboration in support of the strategy and contribute funding to initiatives agreed with other Departments.
- c) Represent the Province of Nova Scotia in collaboration with federal officials and with other Provinces on aspects of the innovation strategy that require inter-governmental co-operation (e.g., in the context of the Atlantic Growth Strategy).
- d) Represent the Province in collaboration with non-government stakeholders in cases where the relevant responsibility does *not* rest within one department or agency.
- e) Generally, act as an advocate for the innovation strategy across the Government of Nova Scotia.

To effectively coordinate and champion the innovative growth strategy, the Department of Business *must* be given financial resources to enable it to fund certain key initiatives both alone and in collaboration with other Departments.

EXECUTIVE SUMMARY: LIST OF RECOMMENDATIONS

Chapter 1 PREPARING THE TALENT FOR AN INNOVATIVE ECONOMY

1.1 Universal Computer Literacy

- a) To establish Nova Scotia as having among the world's most computer-literate populations, continue to enhance and accelerate coding and related computer skills in grades P-12, with a primary focus on using this as a tool for students to develop creativity, logical reasoning, teamwork and problem-solving skills. This initiative will need to be supported with significant continuing investment in teacher training and facilities.
- b) Collaborate with the federal government and private ICT firms to provide greater access throughout Nova Scotia to higher speed and quality broadband internet service.

The foregoing recommendation is foundational, but should be regarded as only one, albeit extremely important, aspect of a broader re-tooling of the basic education system to make it relevant to the learning and innovation skills required to succeed in the digital age. To this end, there is a need, for example, for:

- enhanced mathematics instruction and support;
- learning that encompasses creativity, teamwork, critical thinking and problem solving;
- “maker-spaces” and many more hands-on technology learning experiences;
- entrepreneurial opportunities for grade school students to increase awareness of the nature and benefits of entrepreneurship; and
- more effective practices in turning around low-performing schools. This should lead to better access to post-secondary institutions for students from such schools with the help of programs to improve their readiness to succeed, particularly for under-represented groups in Nova Scotia—specifically, First Nations, African Nova Scotians, and persons with disabilities.

1.2 Work-Integrated Learning

To fulfill an ambition for Nova Scotia to be a talent leader in Canada, post-secondary institutions in collaboration with business and not-for-profit organizations should ensure that all students have the opportunity for a work-integrated learning (WIL) experience, and the Province should increase funding for approved WIL programs to match demand.

1.3 Innovate to Opportunity

To encourage SMEs to become more innovative and export-oriented, the Province should create an “Innovate to Opportunity” program that would:

- a) Provide multi-year support to selected SMEs that hire, on a permanent basis, recent highly-qualified graduates of Nova Scotia post-secondary institutions (typically at the Master’s degree level). Support should be for a minimum of three years to provide time to have a meaningful impact on host company innovation, and front-loaded to increase the incentive to hire.
- b) Select eligible companies, among applicants, based on potential to become exporters or to significantly improve existing export performance.
- c) Co-ordinate with the “SME Export Accelerator” program (Recommendation 4.1) to increase the likelihood that a company is selected for both programs since they are strongly complementary. (Simultaneous selection should not, however, be a requirement of either program.)

1.4 Diversity and Job-readiness—“Atlantic TechHire”

The federal government, through ACOA, should work on an Atlantic-wide basis with the private sector, departments of education, and post-secondary institutions to develop targeted training programs to encourage and increase employment in ICT-intensive occupations for under-represented groups, including First Nations, people of colour, and persons with disabilities.

Chapter 2 BUILDING UP NOVA SCOTIA’S RESEARCH EXCELLENCE

2.1 Creation and Role of “Research Nova Scotia”

- Consolidate and broaden the Province’s post-secondary research granting functions—presently conducted primarily through NSRIT, NSHRF and OERA—in a single organization, “Research Nova Scotia” (RNS). The consolidated organization, which should be structured as a crown corporation, would:
 - a) Focus Provincial research funding on areas of greatest strategic importance for Nova Scotia. (The Province should consult with the full range of research institutions and with researchers themselves to encourage proposals that are particularly relevant to achieving a more innovative Nova Scotia economy.)
 - b) Build upon the strengths of its predecessor organizations (particularly NSHRF and OERA) ensuring that their mandates, experience, and established relationships are well-integrated in RNS.
 - c) Allocate sufficient Provincial funds to maximize funding and benefits from non-provincial (primarily federal) sources through competitive research funding programs

such as CFI, Centres of Excellence in Commercialization and Research, Genome Canada, and others.

- d) Build up the global research excellence of Dalhousie and the excellence in particular fields within other Nova Scotia post-secondary institutions.
 - e) Strengthen research collaboration among Nova Scotia's post-secondary institutions themselves, with others in Canada and abroad, and with business and civil society.
- The Province should make available regular funding to Research Nova Scotia that is sufficient to provide required provincial matching amounts for Nova Scotia winners in federal research granting competitions. In view of the unpredictable matching requirements from year to year, the annual grant for this purpose should be placed in a trust and allowed to accumulate, up to some specified cap.
 - Provide Research Nova Scotia with annual funding to cover the Provincial matching requirement for the growing "Mitacs" business research internship program.
 - Create, within Research Nova Scotia, a new "Research Opportunities Fund" that would support targeted research-based initiatives in areas of particular importance to Nova Scotia. The opportunities could involve, for example, federal research funding competitions or collaborative R&D projects with business partners. Opportunities should be identified according to criteria that include alignment with provincial priorities, research excellence, training of students, and significant leverage of Research Opportunity Funds. The Province should provide RNS with \$5 million per year, for an initial 5-year pilot period, exclusively to support the Fund.
 - The Province should increase, over time, its level of post-secondary research support to the national *per capita* average. In 2017-18, funding of Research Nova Scotia (which will include amounts budgeted under the predecessor organizations) should be sufficient to meet the anticipated amount required in that year to fulfill the mandate elements outlined above.

2.2 Research Collaboration between Business and Post-Secondary Institutions

- Establish within the mandates of the "strategic triad" of Research Nova Scotia, Innovacorp, and NSBI a requirement for mutual collaboration to develop strategies that will increase engagement of PSE researchers with business to work on challenges that are likely to have high economic impact, either in the short or longer term.
- Build on the existing Productivity and Innovation Voucher program by increasing the upper limit per application, which is currently \$25,000. Use the vouchers (which can be redeemed to purchase R&D services from post-secondary institutions) to encourage innovative companies to locate and invest in Nova Scotia.
- In the context of the Atlantic Growth Strategy, NSERC and ACOA should fund an "I-Corps Atlantic", building on LaunchDal's I-Corps initiative to include nodes in each of the Atlantic Provinces.

2.3 Provincial Funding of Mitacs Interns

Provincial funding for Mitacs research internships with business should be increased to match the growth in demand to ensure that there is no business willing to hire a Mitacs intern that does not receive program funding.

Chapter 3 NOURISHING THE STARTUP ECOSYSTEM

3.1 Seed and Venture Capital

- The Province should issue the pending “Request for Proposals” for the new \$25 million private sector seed capital fund (“New Fund”) and ensure that its mandate includes provision of seed and early-stage private investment in ICT-sector companies in Nova Scotia. This fund could potentially become an Atlantic-wide seed fund if the federal government and other Atlantic Provinces agree as part of the Atlantic Growth Strategy.
- The Province should immediately provide \$40 million to recapitalize the Nova Scotia First Fund (NSFF) to ensure sufficient early stage capital for the startup ecosystem. Innovacorp’s mandate should focus on pre-seed, seed and “Series A” follow-on venture capital investments in complex, capital intensive sectors where private investors are reluctant to participate at the earlier stages. These “hard” sectors include health and life sciences, biotechnology, clean technology, ocean technology, agri-food, and advanced manufacturing.
- The NSFF should not allocate more than 50% of its capital to ICT-based companies. Depending on the success of the “New Fund” in providing sufficient investment for ICT startups, the Department of Business should work with the Board of Directors of Innovacorp to progressively reduce the allocation of the NSFF to the ICT sector.
- Innovacorp should continue to act as a limited partner in private sector funds that invest in ICT companies including, for example, in the “New Fund” and Build Ventures.
- Innovacorp’s performance should be measured with a balanced scorecard that evaluates its success in: (a) supporting the growth of the Nova Scotia startup ecosystem; (b) finding, funding and fostering the formation of technology-based companies; (c) attracting private co-investment; (d) helping investees grow export sales and scale internationally; and (e) achieving rate of return targets established by the Province, Innovacorp’s sole shareholder. Quantitative and qualitative measures of these objectives should be developed collaboratively by Innovacorp’s Board of Directors and the Department of Business.

3.2 Incubators and Accelerators

- The Department of Business, through Invest Nova Scotia or Innovacorp, should negotiate an agreement with Volta Labs to provide multi-year operating support subject to outcome agreements, appropriate performance metrics, and financial controls. The amount and term of the funding agreement should be sufficient to provide a measure of stability as well as

enough time to judge performance—e.g., \$750,000 per year over seven years. Similar funding agreements have been entered into with Propel and Navigate, and should be considered for other enabling organizations in the startup ecosystem—i.e. COVE (as described in Chapter 5), CEED, and others.

- Investments by NSFF should be incubated, as appropriate, through the Innovacorp Enterprise Centre (Health and Life Sciences), Technology Innovation Centre (Cleantech) and COVE (Oceantech). To avoid confusion, the first two should be renamed to accurately represent their focus.
- The Department of Business and the Department of Agriculture should work with Innovacorp and Perennia, the agri-tech incubator, to determine the best way to collaborate and facilitate alignment of seed and early-stage investment and accelerator programming to support the agri-tech sector.
- Innovacorp should replicate its successful relationships with out-of-province funds and accelerators—e.g., the Quebec-based cleantech fund and accelerator (Cycle Capital and EcoFuel), and Guelph-based agri-tech accelerator Bioenterprise—to develop similar relationships in other complex sectors, including life sciences and oceantech.
- Innovacorp should increase funding support provided to startup companies for travel to contact potential investors and to improve market awareness. These are areas widely recognized as significant weaknesses of the Nova Scotia startup community. In complementary fashion, PSE institutions should develop course programs in business-to-business sales and this initiative should be complemented with more targeted, short-term training provided by Innovacorp’s incubators.

3.3 Angel Investment Tax Credit

The Province should replace its existing Equity Tax Credit with a *refundable* Angel Investment Tax Credit targeted on high-growth, innovative companies in designated sectors to include at least ICT, life sciences and medtech, cleantech, oceantech, agri-tech, and advanced manufacturing.

- a) Raise the investment limit to \$250,000.
- b) Include as eligible instruments: common and preference shares as well as convertible debentures.
- c) Include as eligible investors: individuals, corporations, trusts and Limited Partners, and as eligible investees: corporations, trusts and Limited Partnerships.
- d) Since the objective is to attract both risk capital and deep sector experience, eligibility for the refundable credit should extend to those in any jurisdiction and not be limited to Nova Scotia.

This could be implemented on an Atlantic-wide basis with the federal government funding the non-resident portion of the refundable tax credit. This could be achieved through the Atlantic Growth Strategy if the federal government and other Atlantic Provinces agree.

3.4 Incubators and Accelerators in Atlantic Canada

The federal government should provide funding for organizations that develop the “connective tissue” of innovation ecosystems in key sectors and clusters—e.g., oceantech; ICT; life sciences and medtech; cleantech; agri-food and aquaculture. To this end:

- a) Eligibility for ACOA funding should include both infrastructure and programming for private sector-led incubators, accelerators, and associated research facilities.
- b) The federal government should ensure that the terms of the Industrial and Technological Benefits program (see Chapter 5) provide enhanced multipliers for infrastructure and program funding for private sector-led incubators, accelerators and associated research facilities.

3.5 Later Stage Venture Capital for Atlantic Canada

- The federal government should continue to fund Build Ventures, a private sector-led “Series A” venture capital fund in Atlantic Canada. This could be done through further direct funding, but ideally it would be supported through a new Atlantic-based fund-of-funds under an extension of the Venture Capital Action Plan (VCAP).
- In addition, a “Series B and C” co-investment fund should be established, initially on a pilot basis, to co-invest in Atlantic Canadian companies on terms that would encourage participation by venture capital investors from outside the region. An Atlantic-based VCAP fund could also invest in private-sector-led seed funds in Atlantic Canada, such as the proposed “New Fund”, Pelorus, and East Valley Ventures.

3.6 Government Procurement to Support Startups

Provincial departments should have a portion of their budgets set aside to purchase from Nova Scotia companies innovative products and services that can credibly claim to improve service and/or lower cost. This could be done on an Atlantic basis, while leveraging the federal Build in Canada Innovation Program (BCIP).

3.7 Regional Innovation Network and Urban Innovation Districts

The Province and ACOA should establish a new fund, managed by Innovacorp, to support a network of regional innovation centres in Nova Scotia and the emerging “innovation districts” in Halifax and Sydney.

- a) Innovacorp, working with universities and NSCC, ACOA, and local communities would determine the appropriate support to the regional innovation ecosystems. This should include financial support to establish or expand co-working space; the delivery of programs to foster innovation and entrepreneurship; and enhancing the role of post-secondary institutions as regional hubs for innovation and development in collaboration with the regional innovation centres.

- b) The fund should support initiatives to further develop the “innovation districts” (i) in Sydney, which is helping to catalyze innovation-driven entrepreneurship in Cape Breton, and (ii) in Halifax, which has the potential to evolve to national scale and serve as the anchor platform for Atlantic Canada’s startup community.

Chapter 4 GROWING INNOVATIVE EXPORTERS

4.1 Export Accelerator Program

In collaboration with ACOA, the Province should establish an Export Accelerator program. The objective is to significantly increase the export ambition and capabilities of selected SMEs through an intensive multi-year program of export strategy development and tutelage led by world-class experts. The program would have the following key features:

- a) Developed and run by an international consulting company of the caliber of, for example, McKinsey, BCG, Monitor Deloitte
- b) Available, based on selection, to SMEs that demonstrate a willingness to improve export performance and have the potential to do so
- c) Organized in annual cohorts of companies (e.g., 10 at a time) that would meet periodically for three years under the guidance of the consultants and selected mentors who have extensive export experience and will be able to provide customized and experience-based advice related to specific sectors and potential markets
- d) Supported by a new “Export Accelerator Fund” to provide customized financial support through grants/loans to promote export success
- e) Graduates of the program to be given preferential consideration in accessing certain government programs that aim to build export readiness
- f) Participating companies to bear a share of the cost with the government assistance front-loaded to encourage initial up-take. A portion of the Accelerator costs could be performance-related based on the growth in Participants’ exports.

NSBI would administer the program in Nova Scotia in close collaboration with, and shared funding from, ACOA. The Export Accelerator Program would have similar benefits throughout Atlantic Canada and could be expanded as part of the Atlantic Growth Strategy, perhaps following a pilot in Nova Scotia.

4.2 Incentives for Foreign Direct Investment

NSBI’s FDI attraction strategy should complement the payroll rebate with greater emphasis on incentives designed to attract more innovative companies. To that end:

- a) The Province’s Productivity and Innovation Voucher program should be expanded to include a second component designed to serve primarily as an FDI incentive, redeemable for purchase from Nova Scotia providers of services that would be attractive to innovative

companies. Management of both the existing voucher (which is targeted at SMEs) and the new voucher should be the responsibility of NSBI whose mandate should be broadened to include the support of *innovation and productivity* of its client companies.

- b) At least 25% of the annual expenditure on payroll rebates (currently about \$12 million) should be allocated to “FDI vouchers”, or other credits, to be redeemed for the purchase in Nova Scotia of goods and services that will enhance the innovation objectives of the investing company—for example: customized training and skills development; R&D collaborations with post-secondary institutions; acquisition of customized equipment and services; investing in, or procurement from, innovative startups; integrating Nova Scotia companies into global supply chains.
- c) The portion of the FDI incentives offered through payroll rebate should be decreased over time depending on experience with alternative innovation-oriented incentives.
- d) The payroll rebate should be made more strategic by complementing the standard rate with an enhanced rate for hiring highly qualified people or people from certain groups that are under-represented in the workforce.

4.3 Support for More Rapid Diffusion of Innovation

- NSBI should expand its Export Growth Program to include “innovation discovery missions” to help smaller firms travel to learn first-hand of the best relevant ideas from around the world.
- The federal government, through ACOA and IRAP, should introduce an Atlantic-wide “Digital Technology Adoption Program”, targeted at export-ready SMEs. (This would be a re-establishment, at a regional level, of a similar pilot program that was discontinued by the previous federal government in 2014 despite a favourable evaluation.)
- The federal government, in partnership with the Provinces, should introduce an Atlantic-wide “Cleantech Adoption Program” to encourage more rapid and extensive business investment in cleantech. Funding could come in part from the federal government’s Low Carbon Economy Fund.

4.4 Enhancing Atlantic Canada’s Tourism and Cultural Advantage

In the context of the Atlantic Growth Strategy, the federal government should establish a “Creative Industries and Tourism Innovation Fund”. In partnership with the Provinces on a shared-cost basis, the Fund would support proposals (referenced below in a Nova Scotia context) to:

- a) Establish new or enhanced festivals and events, with the goal of eventually having at least two signature events—e.g., of the calibre of Celtic Colours or the Halifax Jazz Festival—each month from May through October.
- b) Create a select number of signature destinations—e.g., of the calibre of the world-ranked Cabot Links and Cabot Cliffs golf courses.

- c) Bring the province’s wine, craft beer, and culinary experiences to a level that is unequivocally world-class. (In view of the increasing popularity of high-quality cuisine, particularly using the freshest local ingredients, Nova Scotia has an opportunity to establish itself as a global culinary destination based on an exceptional variety of seafood, boutique agriculture, and local game).
- d) Improve air access with more convenient routes to larger urban centre in Atlantic Canada.
- e) Establish “Creativity Districts” in strategically located communities that have high potential for tourism development and for attracting innovative businesses and exceptionally creative individuals—for example, Lunenburg (as a World Heritage Site), Wolfville (as a university town and centre of a developing wine industry)

4.5 Atlantic Cleantech Strategy

In the context of the Atlantic Growth Strategy, the federal and provincial governments should commit to a multi-year cleantech strategy that would support implementation in Atlantic Canada of the new federal climate change framework. The strategy, supported by dedicated funding from the federal government, would aim to develop cleantech research strengths into export opportunities in areas that have strong commercial promise, including smart grid, energy storage, tidal power, and bioenergy. As a first step, the post-secondary institutions should be asked to strike a group with representatives of industry (including the electric utilities in the four provinces) and relevant government agencies, to develop a 5-year plan for submission via ACOA to the federal government.

Chapter 5 DEVELOPING A WORLD-CLASS OCEANS INNOVATION CLUSTER

5.1 Mobilizing Nova Scotia’s Oceans Innovation Cluster

Create a small senior group in the Department of Business dedicated *full-time* to promote and coordinate the Province’s support of the “Oceans Innovation Cluster” in Nova Scotia. The role of this oceans cluster “champion” would be to:

- a) Spearhead a coordinated effort with the other Atlantic Provinces to secure for Atlantic Canada a share of the \$800 million of federal support earmarked for “innovation clusters”.
- b) Specifically in the Nova Scotia context, work with businesses and the federal government to maximize the benefit of the naval ships contract flowing from the federal Industrial and Technological Benefits/Value Proposition (ITB/VP) policy.
- c) Provide Provincial assistance as required to maximize federal support to the Oceans Innovation Cluster through such programs as the Canadian Accelerator and Incubator Program (CAIP), Centres of Excellence for Commercialization and Research (CECR), Business-Led Networks of Centres of Excellence (BL-NCE), Atlantic Innovation Fund

(AIF), Mitacs. Collaborate with the proposed Research Nova Scotia organization regarding the specific research aspects of these programs.

- d) Foster closer relationships among federal oceans-related research facilities (e.g., DFO, NRC, DRDC), oceans-related businesses, and post-secondary institutions.
- e) Serve as the intra-government champion of the Oceans Innovation Cluster and ensure coordination of various supporting initiatives across the Government of Nova Scotia. A first priority in this regard should be to ensure that COVE is properly launched.

To assist in fulfillment of its role, the oceans cluster champion should create an external advisory group with representation from the key post-secondary institutions, industry, the Halifax Regional Municipality, and the other Atlantic Provinces.

5.2 Centre for Ocean Ventures & Entrepreneurship (COVE)

To ensure that COVE is able to fulfill its role as an anchor institution of Nova Scotia's Oceans Innovation Cluster, the Province should:

- a) On an urgent basis, work with stakeholders—including, but not limited to, provincial crown agencies and the Institute for Ocean Research Enterprise (IORE)—to establish a governance and management structure for COVE that provides sufficient budget and independence for COVE to operate as a private sector organization.
- b) Assist COVE to secure operating support from federal funds earmarked for support of innovation clusters as well as programs that support incubators and accelerators.
- c) Leverage federal funding programs for research and commercialization to support creation at COVE of an industry-led applied research consortium in ocean technology for Atlantic Canada. This could draw on the experience and programs of CRIAQ, a successful Quebec-based consortium in aerospace.
- d) Provide all appropriate support to COVE's efforts to secure funding from one or more large industrial partners in the context of the ITB/VP policy or otherwise.
- e) Make available immediately adequate bridge funding (e.g., \$1 to \$2 million per year) to support COVE's management functions until longer term funding is secured; then a reduced amount once other federal and industry contributions are secured.

5.3 Sustainability and the Oceans Innovation Cluster

"Sustainability" should become a strength of Atlantic Canada's Ocean Innovation Cluster and a motivation for both research and technological innovation. To this end:

- a) COVE's new management should lead a collaboration with representation from industry, relevant federal departments, and the Ocean Frontier Institute to develop a roadmap of areas where sustainability objectives intersect with research and commercial capabilities that are resident in the region, including sensors, robotics, AUVs, and advanced analytics;

- b) Based on this assessment, the federal government should allocate a portion of the \$800 million budget earmarked to support innovation clusters to create an “Ocean Sustainability Innovation Fund” that would support, on a competitive basis, projects that demonstrate innovative approaches to oceans-related sustainability issues. To be eligible, projects would require partnership of at least one business and one research institution.
- c) To encourage further development of projects that demonstrate good commercial potential, the government should permit under the ITB rules a “multiplier” for ITB expenditure related to projects that have been selected for funding under the competitive process recommended in (b) above.

Chapter 6 KEEPING GOVERNMENT FOCUSED ON INNOVATION

6.1 Enabling Innovation in the Government of Nova Scotia

The Province should commit to foster a culture of innovation in public service functions with the goals of stimulating employee creativity, improving service quality, increasing productive efficiency and thereby reducing cost, and creating economic opportunities that inevitably arise from innovative initiative. Early steps to be taken by the government to this end could include the following:

- a) To maximize the economic opportunity created by the pending introduction of the “One Person One Record” electronic health record, create a research lab, applied testing program, and incubator/accelerator facility to develop e-health and mobile-health solutions for the global digital health market.
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- d) Mandate the Department of Internal Services to accelerate the implementation of “digital government” services. To this end, seek first-hand advice from successful pioneers like Estonia, and establish an “Innovation Outpost” at Volta Labs.
- e) Experiment with innovative approaches to social programming by, for example, issuing a Social Impact Bond and assigning provincial staff to engage with the new Change Lab Action Research Institute at Saint Mary’s University.

6.2 Sustaining Government's Commitment to an Innovation Strategy

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Source References

INTRODUCTION	
Figure 1a (Growth of GDP)	Statistics Canada, Cansim table 384-0038
Figure 1b (Growth of Population)	Statistics Canada, Cansim table 051-0001
Figure 1c (Growth of GDP per capita)	Statistics Canada, Cansim tables 051-0001 and 384-0038
Figure 1d (GDP per capita)	Statistics Canada, Cansim tables 051-0001 and 384-0038
Figure 2a Projected Population, 2015-41 – Three scenarios	Nova Scotia Department of Finance
Figure 2b (Projected population of working age)	Nova Scotia Department of Finance
Figure 3 (Productivity in the Business Sector)	Statistics Canada, Cansim 383-0029
Figure 4 (Relative Labour Productivity Trends)	Statistics Canada, Cansim 383-0029; Centre for the Study of Living Standards
Figure 5 (Apple Production in Nova Scotia)	http://www.albertafarmexpress.ca/daily/n-s-sweetens-orchard-renewal-program
Fig. 6 (2 Dimensions of Innovation)	Report authors
Figure 7 (Complementary Business Strategies)	Report authors
Figure 8 (Business R&D as % of GDP; US, Can, OECD)	Organization for Economic Cooperation and Development (OECD)
Figure 9 (Corporate Profits – US and Canada)	Statistics Canada; United States Bureau of Economic Analysis
Figure 10a (Business R&D as % of GDP - Provinces)	Statistics Canada, Cansim table 358-0161
Figure 10b (Total R&D performed)	Statistics Canada, Cansim table 358-0001
Figure 11 (Four Strong Winds)	Report authors
Figure 12 (Business Innovation Ecosystem)	Report authors
Chapter 1: TALENT DEVELOPMENT	
Figure 1.1 (PISA Math Results: 2012)	http://www.oecd.org/pisa/keyfindings/pisa-2012-results.htm
Figure 1.2 (Immigration to NS if at National Average)	Statistics Canada, Cansim 051-0011
Box 1A (Coding as a Tool)	Assembled from various sources by report authors
Box 1B (Pioneers of Coding in Public Schools)	Assembled from various sources by report authors
Box 1C (Co-Op Education Incentive)	Assembled from various sources by report authors
Box 1D (Graduate to Opportunity)	Assembled from various sources by report authors
Box 1E (Tech-Hire)	Assembled from various sources by report authors
Annex (Work Integrated Learning)	http://co-op.bc.ca/sites/co-op.bc.ca/files/2015/ACCE%20Matrix%20-%20final.pdf

Chapter 2: RESEARCH EXCELLENCE	
Figure 2.1 (Higher Ed R&D / GDP - Provinces)	Statistics Canada, Cansim 358-0162
Figure 2.2 (Sources of Higher Ed R&D funding)	Statistics Canada, Cansim 358-0001
Figure 2.3 (Provincial funding of Higher Ed R&D)	Statistics Canada, Cansim 358-0001
Figure 2.4 (NS Research Funding Organizations)	Assembled from various sources by report authors
Figure 2.5 (Strategic Triad)	Report authors
Figure 2.6 Business R&D vs R&D employment)	Organization for Economic Cooperation and Development (OECD)
Box 2A (PSE Advantage)	Assembled from various sources by report authors
Box 2B (HQP Assembly Line)	Report authors
Box 2C (Research Manitoba)	Assembled from various sources by report authors
Box 2D (Commercialization of Research)	Assembled from various sources by report authors
Box 2E (NSCC)	Based on information provided by NSCC
Box 2F (Mitacs)	Assembled from various sources by report authors
Chapter 3: STARTUP ECOSYSTEM	
	Kaufmann Foundation, <i>The Importance of Startups in Job Creation</i> (2010)
Figure 3.1 (Funding a Startup)	Report authors
Figure 3.2 (PSE Map)	Report authors
Figure 3.3 (Halifax Innovation District)	Report authors
Box 3A (Moreira Report)	Entrevestor (2015). Atlantic Canadian Startup Data.
Box 3B (Duruflé Report)	G. Duruflé (2014, June). <i>Fueling Entrepreneurship and Innovation</i> .
Box 3C (Innovacorp)	Innovacorp Business Plan, 2015-16; Innovacorp Business Plan, 2016-17; Innovacorp Accountability Report, 2015-16.
Box 3D (Build Ventures)	Interview with P. Keefe, July 2016
Box 3E (Incubators and Accelerators)	Assembled from various sources by report authors
Box 3F (VCAP)	Federal Budget 2015, Federal Budget 2016, Hurwitz (2013), Auditor General of Canada 2016, Woollett (2016)
Box 3G (Radian6 and Q1 Labs)	Assembled from various sources by report authors
Box 3H (Sandboxes)	Assembled from various sources by report authors
Box 3I (Sydney Innovation District)	Assembled from various sources by report authors
Box 3J (Acadia Entrepreneurship Centre)	Assembled from various sources by report authors
Annex (Sampling of Innovative Startups)	P. Moreira (2016, July)
Chapter 4: INNOVATIVE EXPORTERS	
Figure 4.1 (Provincial Exports)	Statistics Canada, Cansim 384-0038
Figure 4.2 (Principal NS Exports by Category)	Innovation, Science, and Economic Development Canada

4A (Riverside Lobster)	Interview with F. Arsenault, August 2016
4B (Acadian Seaplants)	Assembled from various sources by report authors
4C (Why SMEs Don't Innovate)	P. O'Farrell (1990, March). Small Manufacturing Competitiveness and Performance: An Analysis of Matched Pairs in Nova Scotia and New England.
4D (Michelin)	Assembled from various sources by report authors
4E (Payroll Rebate and Investment Attraction)	Assembled by report authors using NSBI program literature and other sources.
4F (Acadia Wine Institute)	Assembled from various sources by report authors
4G (Cabot Links and Cliffs)	Assembled from various sources by report authors
4H (Verschuren Centre)	Assembled from various sources by report authors
4I (Carbon Cure)	Assembled from various sources by report authors
4J (Two Innovative Bioenergy Startups)	Assembled from various sources by report authors
Chapter 5: OCEANS INDUSTRY CLUSTER	
Figure 5.1 (Oceans Industry Cluster)	Province of Nova Scotia
5A (Halifax Oceans Cluster)	Assembled from various sources by report authors
5B (COVE)	Assembled using program materials from COVE
5C (Dalhousie Oceans Research)	Assembled from various sources by report authors
5D (Clearwater)	Assembled using corporate literature from Clearwater; Reinhardt (2013)
5E (Louisbourg Seafoods)	Assembled from various sources by report authors
5F (Cuna del Mar)	Assembled from various sources by report authors
Chapter 6: PROVINCIAL PRIORITY	
6A (IPAC – TMRI)	www.ipac.ca/documents/IM2016-NovaScotia.pdf
6B (TRIC – IWK)	http://www.iwk.nshealth.ca/research/translating-research-care-tric-healthcare-improvement-research-program
6C (Estonia e-Government)	Estonia Ministry of Economic Affairs and Communications (2014, April); S. Sikkut (2014, June); S. Tamkivi (2014, January)
6D (Volta Outpost)	Assembled from various sources by report authors

Appendix I Research & Development and Commercialization (RDC) Working Group

- Richard Florizone, President, Dalhousie University (Co-Chair)
- Ray Ivany, President, Acadia University (Co-Chair)
- Ava Czapalay, Senior Executive Director, Higher Education, Labour and Advanced Education (Co-Chair)
- Babatunde Awoyiga, Planning and Development Officer, Labour and Advanced Education
- Martha Crago, Vice-President, Research, Dalhousie University
- Kenneth Deveau, Vice-recteur à l'enseignement et recherché, Université Sainte-Anne
- Allan Eddy, Associate Deputy Minister, Natural Resources
- Mark Filiaggi, Associate Vice-President, Research, Dalhousie University
- Janine Fraser, Director, Community Development, ACOA
- Ann-Barbara Graff, Vice-President (Academic & Research), Nova Scotia College of Art and Design
- Stephen Hartlen, Executive Director, Industry Liaison and Innovation, Dalhousie University
- Ian Hill, Associate Vice-President, Research, Dalhousie University
- Richard Isnor, Associate Vice-President, St. Francis Xavier University
- Dale Keefe, Vice-President, Academic and Research, Cape Breton University
- Jeff Larsen, Executive Director, Innovation, Creativity and Entrepreneurship, Dalhousie University
- Gayle MacDonald, Associate Vice-President, Research, Mount Saint Vincent University
- David Mackinnon, Dean, Research and Graduate Studies, Acadia University
- Chuck Maillet, Director-General, Regional Operations, ACOA
- Mike McMurray, Director, Universities and Colleges, Labour and Advanced Education
- Gordon McOuat, Professor, University of King's College
- Kent Roberts, Managing Director, Sector Development & Entrepreneurship, Department of Business.
- Loretta Robichaud, Director, Agriculture and Food Advisory Services, Department of Agriculture
- Wayne St-Amour, Executive Director, Innovation & Entrepreneurship, Nova Scotia Community College
- Kevin Vessey, Dean of Graduate Studies, Saint Mary's University

Appendix II

Indicative List of Innovation Project Meetings

Organization	Individuals Met
ABK Biomedical	Bob Abraham, Daniel Boyd
ACENET	Anne MacKenzie and certain directors
ACOA	Peter Hogan, Janine Fraser, Dina Kalogeropoulos, Marianne Etter, Chuck Maillet, John Kavanagh, Jeff Mullen
Amirix Vemco	Mark Jollymore
	All Presidents of Nova Scotia PSEs
Atlantic Provinces Economic Council	Finn Poschmann
Build Ventures	Patrick Keefe
Business Development Bank of Canada	Thomas Park
Cape Breton Partnership	Keith MacDonald
Cape Breton University	David Wheeler
Cloud Kettle	Greg Poirier
Communitech	Iain Klugman
Cuna del Mar	Robert Orr
Dalhousie Faculty of Computer Science	Andrew Rau-Chaplin
Dalhousie University	Richard Florizone Martha Crago John Newhook Stephen Hartlen Matt Hebb Ian Hill Brendan Hailey
Deloitte	Paula Gallagher
Department of Agriculture	Hon. Keith Colwell, Kim MacNeil, Bruce Osborne
Department of Business	Murray Coolican
Department of Education	Sandra McKenzie
Department of Finance	Thomas Storrington, Alex Chute, Bill Stelle
Department of Health	Peter Vaugahn, Tracey Barbrick, Perry Sankarsingh
Department of Internal Services	Jeff Conrad and Executive Committee
Department of Labour and Advanced Education	Duff Montgomerie, Ava Czapalay
	Elizabeth Beale
East Valley Ventures	Gerry Pond

Entrevestor	Peter Moreira
Genome Atlantic	Steve Armstrong
High Liner Foods	Henry Demone
Innovacorp	Stephen Duff, Rod Burgar, Jeff Grammer, Bob Pelley, Paul Richards
Innovation, Science and Economic Development Canada	John Knuble, Elder Marques, David MacFarlane, Jeff Waring, Howard Waring, Patricia Hearn, and other senior staff
IORE	Jim Hanlon
IWK Health Centre	Patrick McGrath
Just Innovations, COVE Feasibility Study Author	Justin Manley
Louisbourg Seafoods	Adam Mugridge, Glen Fewer
Maritime Travel	Rob Dexter
Mentorcamp	Permjot Valia
Metamaterials	George Palikaras
Mitacs	Marc-Etienne Ouimette, Brennan Gillis
Nova Scotia Business Inc.	Laurel Broten, Peter MacAskill, Beth Girard
Nova Scotia College of Art and Design	Dianne Taylor-Gearing and Dr. Ann-Barbara Graff
Nova Scotia Community College	Don Bureaux, Wayne St-Amour
Nova Scotia Health Research Foundation	Krista Connell, Marli MacNeil, and senior staff
Nova Scotia Tourism Agency	Fred Morley
NRstor	Annette Vershuren
Office of the Premier	Laurie Graham, Ryan Grant, Kristan Hines, Bernie Miller
Office of the Prime Minister of Canada	Michael McNair
Oxford Frozen Foods	David Hoffman
Pelorus	Tom Hayes
Perennia	Jo Ann Fewer
Provincial RDC Work Group	See Appendix 1
QRA	Jordan Kyriakidis
Quebec City Conference	Gilles Duruflé
Queen's University School of Policy Studies	Eugene Lang
Riverside Lobster	Frank Arsenault
Scotian Gold	Larry Lutz
Shaw Group	Bert Frizzell
Springboard Atlantic	Chris Mathis
	Tom Traves (Former President, Dalhousie University)
Turbulent Research	Chris Loadman

Verschuren Centre for Sustainability in Energy and the Environment	Andrew Swanson
Volta Labs	Jesse Rodgers, Melody Pardoe

Dr. Peter Nicholson

Educated in physics (BSc, MSc, Dalhousie) and mathematics (PhD, Stanford), Dr. Nicholson has served in numerous posts in government, business, science, and higher education. His public service career included positions as Deputy Chief of Staff (Policy) in the Office of the Prime Minister of Canada; Member of the Nova Scotia Legislature; Clifford Clark Visiting Economist in Finance Canada; and Special Advisor to the Secretary-general of the OECD in Paris. Dr. Nicholson's business career has included senior executive positions with Scotiabank in Toronto, BCE Inc. in Montreal, and H.B. Nickerson & Sons in North Sydney. Dr. Nicholson began his career in the academic sector where he taught computer science at the University of Minnesota (1969-73). He was an original member of the Canadian Prime Minister's National Advisory Board on Science and Technology, the founding Chair of the Board of the Fields Institute for Research in Mathematical Sciences and was the founding Chair of the Members of the Canada Foundation for Innovation and of the Millennium Scholarship Foundation. Between 2006 and 2010 he was the founding President and CEO of the Council of Canadian Academies, where he oversaw several expert panel studies on innovation in Canada. Dr. Nicholson is a Member of the Order of Canada, and has received honorary degrees from Acadia, Dalhousie, the University of Québec, McMaster, and Queen's.

Jeff Larsen

Jeff Larsen is the Executive Director of Innovation, Creativity and Entrepreneurship at Dalhousie. He has served in Executive Director roles at the Province of Nova Scotia, most recently in the Office of Planning and Priorities, and before that in the Investment and Trade division of Economic Development. His work at the Province also included acting as the CEO of both ReNova Scotia Bioenergy Inc. and the Strategic Opportunities Fund Inc., and as a director of DSME Trenton Inc. His work at the Province has focused on innovation, startups, entrepreneurship, education, foreign direct investment, trade, as well as knowledge- and technology-based industries. Jeff has practiced law at McInnes Cooper in Halifax, and in Toronto with Fasken Martineau and CIBC. He has also held senior positions in the investment sector as Vice-President and General Counsel of Halifax-based Clarke Inc. and as Executive Director of Business Management and Chief Compliance Officer with CIBC Asset Management Inc. in Toronto. Jeff also has entrepreneurial and management experience with new businesses in the energy sector, including as a co-founder of Seaforth Energy, Watts Wind and Katalyst Wind. He has been on the Board of Directors of private and TSX-listed public companies, and remains active in his community through volunteer efforts. Jeff holds a Bachelor of Arts from McMaster University, a *Juris Doctor* from the University of Toronto, a Master of Laws from Osgoode Hall Law School, York University and an MBA from Imperial College, University of

London. Jeff has taught Commercial Law Faculty at Saint Mary's University and was previously the Assistant Director and Guest Lecturer in the Osgoode Hall Law School Master of Laws (Securities Law Program). He was also a guest lecturer at the University of Malawi Law School in October, 2007. Jeff is the co-editor of the book Corporate Governance and Securities Regulation in the 21st Century (with Poonam Puri).

Alexander Ripley

Alexander Ripley is a recent graduate of the MA program in Political Science at Dalhousie University. He also holds a BA (Hons.) from Trinity College at the University of Toronto, and has completed coursework at the University of Edinburgh. Alexander's research interests are presently concerned with the implications of component trade, financial innovation, and complex economic interdependence for mainstream international relations theory. Since 2014, he has also been a member of the residence life staff at the University of King's College, and has provided instructional and research support for the Department of Political Science and the College of Sustainability at Dalhousie.

Erik Fraser

Erik Fraser was born in Halifax, Nova Scotia. He holds a BA in environmental studies and international relations from Mount Allison University, and an MSc in education (Higher Education) from the University of Oxford. He recently graduated with an MPA from the Dalhousie School of Public Administration where he was the 2016 recipient of the IPAC Lieutenant Governor's Academic Award of Excellence. Erik's interdisciplinary background in higher education, environmental studies, public administration, economics, and health has been developed throughout his academic and professional career.

Appendix IV

NOVA SCOTIA'S PERSPECTIVE ON THE ATLANTIC GROWTH STRATEGY

The Atlantic Growth Strategy is a partnership between the Government of Canada and the four Atlantic Provinces. It is intended to drive economic growth in the region by implementing targeted, evidence-based actions under the following five priority areas (the “Atlantic Growth Priority Areas”): Skilled workforce/immigration; Innovation; Clean growth and climate change; Trade and investment; and Infrastructure.

The Government of Canada is also developing an Innovation Agenda designed to build an inclusive and innovative Canada. The Innovation Agenda has six priority areas (the “Innovation Agenda Priority Areas”): an entrepreneurial and creative society; global science excellence; world-leading clusters and partnerships; growing companies (e.g. startups and scale-ups) and accelerating clean growth; competing in a digital world; and improving ease of doing business.

The Province of Nova Scotia, in collaboration with the three other Atlantic Provinces, should work with the federal government’s Department of Innovation, Science and Economic Development (ISED) and the Atlantic Canada Opportunities Agency (ACOA) to implement the following initiatives from the Innovation Strategy, all of which directly align with one or more of the Atlantic Growth Priority Areas and the Innovation Agenda Priority Areas.

Note that this document does not address immigration. Although Atlantic Canada needs more immigrants and international students to enhance the base of technical and entrepreneurial skills and to help offset the economic impact of a declining, ageing population, the Atlantic Growth Strategy has already announced a pilot project with ambitious targets, and therefore this document focuses on other areas.

1. Oceans Super Cluster

Canada has a world class Oceans Cluster (with poles in Halifax and St. John’s) which is part of an east coast “super cluster” that includes an agglomeration of world-class research facilities and ocean tech companies from Atlantic Canada, and which stretches along the New England coast to south of Boston. Canada’s contribution to the super cluster needs to be upgraded to more nearly match the depth and capability of the US component. The naval ships contract along with the recent investments in the Centre for Ocean Ventures and Entrepreneurship (COVE) and the Ocean Frontier Institute (OFI), can create a genuinely world-class centre of ocean innovation, but only if the recent momentum is sustained. The federal government should identify a portion of the funding earmarked for innovation networks and clusters (\$800M over the next four years) for the Atlantic Oceans Cluster. Initially this should include, among other things, significant

operational and program funding to “kickstart” COVE. It should also include funding to support the development by COVE of functions analogous to that of the Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ) in the Montreal aerospace cluster, including a collaborative industry-led applied research consortium for Atlantic Canada in ocean technology at COVE. This funding should also support an Ocean Sustainability Innovation Fund that would support, on a competitive basis, projects that demonstrate innovative approaches to oceans-related sustainability issues. In addition, to encourage further development of projects that demonstrate good commercial potential in the ocean sector, the government should permit under the Industrial and Technological Benefits (ITB) and Value Proposition (VP) rules a “multiplier” for ITB expenditures related to projects that support the Oceans Cluster, including the operational and program costs of COVE, the collaborative industry-led applied research consortium for Atlantic Canada in ocean technology at COVE, and the Ocean Sustainability Innovation Fund.

2. Atlantic Startup Ecosystem

The Atlantic region’s startup ecosystem straddles a thinly-populated geography with primary nodes in seven cities—St. John’s, Charlottetown, Saint John, Moncton, Fredericton, Sydney and Halifax. Each has its own local ecosystem and the whole is supported by several Atlantic-wide institutions and programs—for example: Build Ventures, Propel, Gerry Pond’s East Valley Ventures, First Angels Network, ACOA’s Atlantic Innovation Fund (AIF) and Business Development Program (BDP), and other federal innovation supports delivered through the SR&ED tax credit, IRAP and the research granting councils. The Atlantic Startup Ecosystem has achieved remarkable successes recently — roughly \$1.5 billion realized in several prominent “exits” over the past five years: (\$540 million for Ocean Nutrition; \$500 million for Q1 Labs; \$340 million for Radian6; \$70 million for GoInstant; \$20 million for Compilr.) Nonetheless, a bias against Atlantic Canada by both public sector and private venture investors persists, reflecting the region’s have-not reputation. While the exceptional quality of talent in the region is acknowledged, the fact remains that the pools of potential angel, seed and venture capital and related expertise are still shallow. As part of the Atlantic Growth Strategy, the federal government should develop a program specific to these challenges in Atlantic Canada.

The Atlantic Growth Strategy should leverage federal funding under the Innovation Agenda and other programs to support the following:

- *Atlantic Incubators and Accelerators.* Eligibility for ACOA funding should include infrastructure, operational and programming for private sector-led incubators, accelerators, and associated research facilities to ensure adequate funding for Volta, Propel, Navigate and other key players in the Atlantic innovation ecosystem (e.g. Venn, Planet Hatch, Common Ground, LaunchPad PEI).

- *Atlantic Angel Investor Tax Credit.* The federal government and Atlantic provinces should introduce an Atlantic angel investor tax credit such as that proposed earlier for Nova Scotia, which would apply to any investor regardless of geography with the federal government funding the non-resident portion of the refundable tax credit.
- *Atlantic Seed Capital Fund.* The federal government and the other provinces should co-invest in the proposed \$25 million private-sector-managed “New Fund” being catalyzed by Nova Scotia, and turn it into an Atlantic Canada regional seed capital fund rather than a provincial seed capital fund.
- *Atlantic Early Stage Venture Capital Fund.* The federal government should continue to fund a private-sector-led Series A venture capital fund in Atlantic Canada. This could be done through further direct funding of Build Ventures, but ideally it would be supported through a new Atlantic-based VCAP fund-of-funds. BDC should consider re-opening an office in Halifax to support investments by BDC’s IT, health and life sciences, and cleantech venture capital funds.
- *Atlantic Late Stage Venture Capital Co-investment Fund.* The federal government should establish a Series B and C co-investment fund, initially on a pilot basis, to co-invest (in Atlantic Canadian companies) on preferable terms with venture capital firms from outside the region. An Atlantic-based VCAP fund could also invest in private-sector led seed funds in Atlantic Canada, such as the proposed New Fund, Pelorus, and East Valley Ventures.

3. Clean Energy Fund and Cleantech Adoption

Climate change and environmental sustainability will be a mega-trend of the 21st century, changing the way we live and work and disrupting existing industries worldwide, but creating in their place a healthier, more efficient and sustainable economy. Although the scale and scope of change will disrupt certain industries, particularly in carbon-intensive sectors, it will also create unprecedented opportunities for new businesses and jobs in a low-carbon economy. Cleantech presents new opportunities to create innovative businesses but can also contribute to the efficiency of established businesses—e.g., by cutting energy or material consumption. Sometimes a cleantech solution will be needed to meet increasingly stringent regulatory requirements, or a *de facto* requirement to be acceptable to consumers. For these reasons, the diffusion and adoption of cleantech by businesses and institutions in Atlantic Canada can boost competitiveness while at the same time contributing to public environmental objectives.

In the context of the Paris Agreement on Climate Change (in which Canada committed to cut greenhouse gas (GHG) emissions by 30% below its 2005 level no later than 2030), the federal government has announced that all Provinces must agree to impose “a price on carbon” or face a federal requirement to that effect. Nova Scotia has in fact already reduced its GHG emissions by 30% below their 2005 and has increased to 27% the contribution of renewables in its electricity mix and is on track to hit 40% by 2020. The further imposition of a carbon price—via a new tax

or cap-and-trade regime—would increase the province’s already high power prices, thus penalizing one province that has already met the 2030 reduction target.

The Atlantic Growth Strategy aims to develop a clean energy plan for Atlantic Canada by the end of 2016, and this plan should include a focus on cleantech opportunities. The federal government, in Budget 2016, committed to invest more than \$1 billion over four years, starting in 2017-18, to support clean technology, including in the forestry, fisheries, mining, energy and agriculture sectors. The federal government also appears to recognize the importance of technology diffusion to support GHG reduction, and has proposed a two-year \$2 billion Low Carbon Economy Fund to achieve significant reductions. A portion of these commitments, via the Atlantic Growth Strategy, would provide a fiscal foundation for an Atlantic Cleantech initiative as outlined below.

In the context of the Atlantic Growth Strategy, the federal and provincial governments should commit to a multi-year cleantech strategy that would support implementation in Atlantic Canada of the new federal climate change framework. The strategy, supported by dedicated funding from the federal government, would aim to develop cleantech research strengths into export opportunities that have strong commercial promise, including smart grid, energy storage, tidal turbines and bioenergy. As a first step, the post-secondary institutions should be asked to strike a group with representatives of industry (including the multiple electric utilities in the four provinces) and relevant government agencies, to develop a 5-year plan for submission to ACOA and the federal government.

To encourage more rapid adoption and diffusion of cleantech, the federal government could create an Atlantic-wide “Cleantech Adoption Program” delivered through IRAP and ACOA. This could also involve provincial partnerships with, for example, Invest Nova Scotia, NSBI and/or Efficiency One (formerly Efficiency Nova Scotia) in Nova Scotia. The Atlantic Growth Strategy and the Low Carbon Economy Fund should support the Atlantic Cleantech Adoption Program.

4. R&D, Innovation and Exporters

Export performance is the acid test of competitiveness over the longer term as the impact of fluctuations in currencies and business cycles tend to average out. Successful exporters, almost by definition, tend to be innovative and growth-oriented and create more jobs. In short, exporters are the principal source of dynamism in an economy. Sustained export success depends on maintaining global competitiveness which depends on a combination of innovation (to make one’s product more attractive) and productivity (to make it more cost-efficiently). Businesses in Nova Scotia, and indeed in Atlantic Canada, invest less in R&D, productivity and innovation than their counterparts in Canada, and not surprisingly have much lower exports.

Some of the most successful approaches around the world for incenting business-driven R&D – Israel’s OCS, Finland’s Tekes, Enterprise Ireland, U.S. SBIR—provide generous grants to business (50% or more) for innovation, including both for R&D and for subsequent commercialization. The emphasis in Canada has been on tax-based assistance (SR&ED credit) with a repayable feature for early-stage companies that may not have taxable income. Several observers have suggested that Canada’s R&D assistance should be re-balanced with a much greater proportion delivered via targeted grants. In that spirit, through the Atlantic Growth Strategy, changes could be made to the AIF Program to support R&D and innovation projects between \$500,000 and perhaps \$5 million (increased from \$3 million currently). In addition, the program could be applied with greater flexibility for business-driven innovation projects that are further toward the “development” end of the R&D continuum and the incentive for participation by business could be increased so that up to 50% of the provisionally repayable loan could be a grant, with a greater percentage in the case of startups, resource-based or rural industries.

Adoption of digital information and communications technologies (ICT) is a key enabler of competitiveness. Businesses in Atlantic Canada invest less in digital technologies than Canadian firms generally, and Canadian firms have long trailed far behind the US. In order to support the adoption of digital technology by Atlantic Canadian businesses, the Atlantic Growth Strategy should create a program to help fund digital technology adoption by Atlantic Canadian firms, similarly to the former Digital Technology Adoption Pilot Program (DTAPP).

A core objective of an innovation strategy for Nova Scotia, and indeed for Atlantic Canada, must be to improve substantially the export performance of small and medium-size enterprises (SMEs), particularly in the traditional resource sectors, in manufacturing, and in tourism (understood as an export earner). The Innovative Growth Strategy for Nova Scotia recommends the creation of an Export Accelerator program to significantly increase the export ambition and capabilities of selected SMEs through an intensive multi-year program of export strategy development and tutelage led by world-class experts. Although the Export Accelerator Program is recommended for Nova Scotia with 50% contribution to the program by ACOA, but it would have benefits across Atlantic Canada and could be expanded as part of the Atlantic Growth Strategy.

5. Rural and Resource-based Innovation

The population of most rural areas throughout North America has been in decline for decades as the structure of the economy has evolved from its former base in land and resources toward services and amenities that concentrate naturally in urban areas. This long-term movement of people has been amplified by the extraordinary productivity gains brought about by innovation in agriculture and all other resource-based and manufacturing industries. While these facts of

history must be taken as given, the land and sea-based activities in Atlantic Canada are far too valuable, in both economic and socio-cultural terms, to be simply left to decline past the point of no return. But since the march of technological innovation cannot be turned back, it needs instead to be embraced to enable much greater value to be earned from the region's resources, among which must be included great natural beauty and cultural charm. By bringing innovation and export market development fully to bear on Atlantic Canada's resources, their value can be vastly increased so as to generate the income growth needed to stabilize, and then reverse rural decline. There are many examples of businesses in rural Atlantic Canada that demonstrate what success can look like. They show that if we are held back, it is not for want of possibility.

The Atlantic Growth Strategy has articulated an approach to rural development that mirrors themes emphasized throughout this report. The Strategy, in respect of Atlantic Canada's rural and small town economy, is focused on:

- supporting innovation and spurring value-added opportunities in established industries like the fishery, agriculture, minerals and forestry which remain foundations of Atlantic Canada's economy;
- enhancing research and innovation in areas such as biosciences, aquaculture, ocean technology, renewable energy, fisheries, agriculture and forestry;
- investing in regionally significant infrastructure projects, including broadband connectivity; and
- developing a strategic and collaborative approach to tourism.

6. Creative Industries and Tourism Fund

The Atlantic Growth Strategy identifies an opportunity for a more strategic and collaborative approach to tourism, and more generally, to development of the cultural industries. This represents a significantly under-exploited opportunity in Atlantic Canada. But it will require a major upgrade of the visitor experience with much greater emphasis on experiential elements including high-quality local cuisine; wilderness and coastal recreation; interactive forms of engagement with the region's history; more events that showcase the region's cultural richness. When considering government investments in tourism and cultural development, it should be recognized that the same investments that will attract more visitor expenditure from outside the region will also make Atlantic Canada even more appealing to its own residents. This would, at the same time, greatly enhance the region's attractiveness to what Richard Florida has called the "creative class"—those individuals who are at the cutting edge of innovation. In the context of the Atlantic Growth Strategy, the federal government should establish a "Creative Industries and Tourism Innovation Fund". In partnership with the Provinces on a shared-cost basis, the Fund would support proposals (referenced below in a Nova Scotia context) to:

- a) Establish new or enhanced festivals and events, with the goal of eventually having at least two signature events—e.g., of the calibre of Celtic Colours or the Halifax Jazz Festival—each month from May through October;
- b) Create a select number of signature destinations—e.g., of the calibre of the world-ranked Cabot Links and Cabot Cliffs golf courses;
- c) Bring the province’s wine, craft beer, and culinary experiences to a level that is unequivocally world-class. (In view of the increasing popularity of high-quality cuisine, particularly using the freshest local ingredients, Nova Scotia has an opportunity to establish itself as a global culinary destination based on an exceptional variety of seafood, boutique agriculture, and local game);
- d) Improve air access with more convenient routes to larger urban centre in Atlantic Canadas;
- e) Establish “Creativity Districts” in strategically located communities that have high potential for tourism development and for attracting innovative businesses and exceptionally creative individuals—for example, Lunenburg (as a World Heritage Site), Wolfville (as a university town and centre of a developing wine industry)

7. Promoting Diversity and Job-readiness in Technology-intensive Occupations

The STEM (science, technology, engineering, mathematics) subjects underpin an increasing number of occupations that are in high demand now and in the future—for example; skilled trades, engineers, computer scientists, data analysts, and health care professionals. Meanwhile, the employment rate among “under-represented” groups in Atlantic Canada is unacceptably low in general and even more so in occupations that require STEM skills at the high school level or beyond. There is a double cost as a result—groups that are already disadvantaged miss out on opportunities for many of the good jobs of the future, and technology-intensive occupations that face looming labour shortages have less potential talent available. These shortcomings can be at least partly addressed with programs that combine employment opportunity with tightly-targeted training for job readiness in occupations that require various levels of ICT competence. As part of the Atlantic Growth Strategy, the federal government, through ACOA, should work on an Atlantic-wide basis with the private sector, departments of education, and post-secondary institutions to develop targeted training programs to encourage and increase employment in ICT-intensive occupations for under-represented groups, including First Nations, people of colour, and persons with disabilities.

Effective sales training is vital for business growth but has been frequently identified as a significant weakness in early-stage companies in Nova Scotia (and more generally in Canada). In order for SMEs and larger firms in Nova Scotia to grow and expand export markets, they need employees with top-notch sales skills. Academic programs across the province are currently lagging in providing adequate sales training to students, even those in business and commerce programs. UNB Saint John has started to offer sales courses for MBA candidates, but has yet to introduce the subject at the undergraduate level.

Included below is a draft syllabus for a first-year Bachelor of Commerce course in sales that would additionally be open to employees of Nova Scotian SMEs. The course was designed by Greg Poirier, President of Cloud Kettle, as an introduction to the theory and practice of sales. It is designed to teach students how to analyze, research, adopt best practices, and improve confidence. Mr. Poirier and his colleagues have offered to provide voluntary support for the course if it is adopted by a Nova Scotian PSE.

Business-to-Business (B2B) Sales and Marketing in a Digital World: Basic Level

Instructor: Existing Faculty or Business Leader

Welcome to *B2B Sales and Digital Marketing*, a half semester certification.

During this intensive set of workshops, you will learn:

- What early-stage companies need to know before beginning sales and marketing
- How to configure, customize and implement a Customer Relationship Management (CRM) tool
- The basics of lead generation-focused digital marketing
- The sales lifecycle and how to use a CRM and Marketing Automation to shorten the length of time it takes to move a prospect through it
- How to begin pursuing sales for an organization and how to build the tools necessary to achieve sales

Objectives

This set of workshops is designed to help early stage B2B companies understand the importance of sales and marketing activities in laying a solid foundation for revenue growth.

It provides a unique opportunity for students to gain hands-on experience in sales. The course allocates time equally between learning of theory and practice. Throughout the course, each participating company will build out its own customized CRM, add leads to it, and create sales enablement materials. The objective is that each participant will complete the course with advice and actual tools needed to immediately begin selling their products.

Material by Week:

1. What you need to know before you can market and sell your organization
2. The Customer Lifecycle and the CRM Ecosystem
3. Minimal Viable Sales and Marketing
4. Generating Leads through Inbound Marketing
5. Sales Enablement
6. Qualifying and Working leads

Marking Scheme

This is a pass/fail course and individuals who successfully complete the program will receive a certificate in start-up sales and marketing.

- Assignments and Reflections on class activities - 70%
- Attendance and Participation - 30%

Textbook

There is no textbook for this course. Students will be assigned readings by the instructor for a collection of online article and should ensure that all readings are completed as class participation involves hands-on work.

