



**DALHOUSIE
UNIVERSITY**

Inspiring Minds

Dalhousie University Strategic Research Plan

For the Canada Foundation for Innovation and Canada Research Chairs Program

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Strategic Research Plan

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Strategic Research Plan

I. Introduction

We live in a dynamic world. It is constantly changing and adapting to economic, environmental, health, societal and cultural challenges. Dalhousie University engages in addressing these challenges through its main pillars of research: discovery, creation, exploration, reflection, teaching and knowledge sharing.

Dalhousie is recognized for the outstanding quality of its research, creative initiatives and the opportunities that these provide for its students. The research strength of the institution derives from the contributions of over a thousand researchers and the engagement of students at all stages of study, supported by research funding from governments, industry and non-governmental organizations.

This Strategic Research Plan outlines Dalhousie's research priorities and serves as a guide for the allocation of resources so that our research activities have an even stronger impact on the regional, national and global landscape.

II. Overview of Dalhousie University

Founded in 1818 in Halifax, Nova Scotia, Dalhousie attracts more than 18,000¹ high achieving, motivated and engaged students from around the world. Dalhousie is classified as a medical doctoral university. Its four campuses offer a broad range of educational and research activities in more than 190 undergraduate and graduate programs across 12 faculties.

Dalhousie is committed to "Inspiring Minds". It provides a unique, interactive and collaborative environment for creating and sharing knowledge with diverse, challenging, career-oriented academic programs and excellent research. Dalhousie students, faculty, staff and alumni make significant contributions to the region, Canada and the world. In Nova Scotia alone, Dalhousie generates nearly \$1 billion in economic benefits each year.

Dalhousie's Mission & Vision

Mission

Learning, discovery and innovation and social engagement (with our students, the university and the world).

Vision

Dalhousie will become Canada's best university, committed to advancing provincial and regional development by attracting and offering a diverse student body an outstanding personal experience at a national university built around an excellent learning environment, acclaimed research strengths, broad program choices and successful career preparation in cooperation with supportive external stakeholders.

III. Research at Dalhousie University

Dalhousie University is a member of the U15 group of leading research-intensive universities in Canada. The university attracts more than \$140 million in research grants and awards each year, making it the largest research university in the region. Indeed, more than 25 per cent of the university's total budget is from research funding. Dalhousie embraces interdisciplinary

¹ All numbers used in this document are current as of April 2013.

collaborations within the university, across Canada and around the world to address complex scientific and societal challenges.

Enriched Learning Environment

Dalhousie supports research excellence by fostering a dynamic learning and research environment led by top professors and researchers in their fields. Dalhousie's professors mentor over 3,500 graduate students and post-doctoral fellows in a multidisciplinary, research-intensive setting by bringing their research to the classroom and offering opportunities for students at all levels to be engaged. Dalhousie has been particularly successful in attracting graduate student funding from the Natural Sciences and Engineering Research Council (NSERC) Collaborative Research and Training Experience (CREATE) program. It has secured six awards in the programs first five years of existence. These awards recognize and support Dalhousie's leadership in developing innovative new ways of training the next generation of scientists and knowledge-based workers.

Discovery

The university embraces discovery research, creation and the dissemination of knowledge through scholarly publications and performances. It recognizes that fundamental research is foundational and highly important to informing an understanding of the world through the postulation of theory, as well as to eventual applications.

Innovation and Economic Impact

Dalhousie University's research has a substantial economic impact on the region and nation in a variety of ways. First, research laboratories, offices and centres are employment settings. Some are comparable to small businesses that employ a large number of highly qualified personnel.

Second, the economic strategy for Nova Scotia, and indeed Canada, is to become a knowledge-based economy. Dalhousie is Atlantic Canada's training engine for such an economy, producing more than 1000 highly qualified graduate students and postdoctoral scientists and scholars each year.

Third, through industry engagement, Dalhousie researchers are actively involved in helping small and large-scale industries in Nova Scotia and beyond, by developing new products, services and processes. This expertise also attracts international corporations to the region and leads to the creation of new companies.

Dalhousie also supports research, innovation and commercialization with state-of-the-art facilities that are accessible to local industry. These facilities help attract world-class researchers and students. Dalhousie researchers generate new inventions and technologies that are patented and may be licensed to local or global company partners and spin-off ventures. The commercialization of research creates jobs, more competitive industries, increased productivity and better goods and services for the public.

Social Engagement

The results of research at Dalhousie are far-reaching in their applications. The university's researchers address a range of social, cultural and health issues pertaining to a variety of social

settings and cultural communities. Working in partnership with communities, non-governmental agencies and governments, researchers inform new public policy and improve social and health services and social well-being.

IV. Research Administration

The Office of the Vice-President of Research

The mission of the Office of the Vice-President of Research is to facilitate research excellence and impact. The office:

- Seeks opportunities for new collaborations and research partnerships
- Serves as a catalyst for new initiatives
- Develops research policy for the university
- Informs and advises senior administration on research initiatives
- Promotes research carried out at Dalhousie and encourages the university's involvement in international research and development activities
- Advocates for government support for research
- Maximizes the communication of research
- Supports university researchers by working to remove impediments to obtaining external research funding

The office consists of the Vice-President Research, Associate and Assistant Vice-Presidents, their assistants and a Communications Officer.

Dalhousie Research Services

Dalhousie Research Services includes six units: Research Grants and Contracts; International Research and Development; Institutional Strategic Initiatives; Industry Liaison and Innovation; the Scholarly Integrity Officer and the affiliated Research Ethics Office. Dalhousie Research Services:

- Advises faculty members on sources of research funding from governmental granting agencies, the public and private sector, charitable organizations, foundations and non-governmental organizations
- Establishes and reviews research administrative processes to ensure effectiveness and efficiency
- Reviews and facilitates grant applications and contract proposals
- Represents Dalhousie researchers in negotiations with research funding sponsors
- Provides post-award administrative support

Dalhousie Research Services also assists in the organization, preparation and presentation of collaborative research ventures and represents the university on industry, government and community bodies concerned with research policies and research administration.

Industry Liaison and Innovation

Dalhousie actively fosters innovation, entrepreneurship and industry engagement to increase research and development, as well as knowledge transfer to industry for public and economic development benefits. The Industry Liaison and Innovation office commercializes research at

Dalhousie, manages and facilitates collaborations between companies and university researchers, assists in the creation of spin-off ventures and supports researchers and industries in developing funding proposals for industry-university collaborations.

V. Strategic Research Plan – Purpose, Principles and Process

Purpose

Dalhousie's research objectives are:

- To maintain and build capacity for excellent research in areas of current or emerging strength
- To recruit outstanding scholars to Dalhousie University
- To enhance research networking and collaboration across the university, nationally and internationally
- To provide an outstanding training environment for highly qualified personnel
- To enable the translation of research results for the benefit of society

Maintain and build capacity

The university and its affiliated teaching hospitals have more CRCs than any other university in the region (see Appendix 1). Canada Research Chairs advance the frontiers of knowledge in their fields, not only through their own work, but also by teaching and supervising students, coordinating the work of other researchers and undertaking interdisciplinary collaborations.

Recruit outstanding scholars

Metrics of research funding and productivity are used by the university in its strategic planning, including its allocation of CRCs. The university strategically selects its CRCs by aligning them with priority research areas. Dalhousie nominates individuals whose work will enhance a priority research area of the university and is aligned with its collaborative, multidisciplinary environment. The majority of the university's CRC allocations are used for external hires of the most qualified people, whether they have a national or international background. All CRC applicants at Dalhousie have the opportunity to apply for funding from the Canada Foundation for Innovation's (CFI) Leaders Opportunity Fund (LOF).

Dalhousie University is committed to employment equity and affirmative action practices and makes every effort to attract, recruit and retain members from the traditionally under-represented groups of Aboriginal people, persons with a disability, racially visible persons and women.

Enhance networking and collaboration

Dalhousie promotes a cooperative, collaborative and interdisciplinary approach to research across faculties and is designed to foster new partnerships with other regional, national and international universities, affiliated teaching hospitals, non-governmental organizations, communities, governments and industry. The university will build on existing partnerships with other institutions to develop exceptional research strengths. Dalhousie, for example, is home to two Networks of Centres of Excellence (NCE) and participates in many others.

Provide an outstanding environment

CFI alone has awarded more than \$80 million to over 200 projects at Dalhousie. CFI investments include \$35 million for the Ocean Tracking Network, \$5.6 million for neural function restoration

research and \$1.8 million for the Automotive Partnership Canada initiative. CFI investments, many matched by the Nova Scotia Research and Innovation Trust (NSRIT), have created world-class laboratory space and enabled the purchase of new research equipment for the university.

The Dalhousie research environment is also growing by increasing its number of Industrial Research Chairs (IRCs) and leading or participating in numerous partnership programs, as well as promoting researchers for national awards. The strength of Dalhousie's support for research is evident in the provision of a number of University Research Chairs, endowed chairs, University Killam Chairs and multi-faculty and faculty-based research institutes and centres.

The university and its government partners have invested in state of the art research infrastructure such as the Life Sciences Research Institute and the Dalhousie Ocean Sciences Building.

Translation of Research Results

Dalhousie shares the news about its research through a number of avenues including peer reviewed publications, institutional repositories, media and events, both on and off the campus, that are open to the public.

Principles

The university recognizes that to attain excellence, choices must be made and priorities must be set. The Strategic Research Plan has been developed to meet these objectives, identify areas in which the university will focus its efforts and propose the allocation of resources. For example, the Strategic Research Plan will be used to guide decisions concerning Canada Research Chair (CRC) distribution and infrastructure investment through CFI and other sources of funding to build on current and emerging capacity.

Process

The priorities identified in this document are the result of an iterative process. Deans and Associate Deans encouraged their Departments and Faculties to define and refine research goals, which have informed the identification of the research themes. The process also examined levels of research activity and awards within the past decade, as well as the university's potential growth areas for the next decade.

This Strategic Research Plan has been reviewed by Deans, the Dalhousie Research Advisory Committee and the Vice President Research of the affiliated hospitals and approved by the University Senate.

VI. Priority Research Areas

The priority research areas in this plan have local, provincial, regional, national and international impact. Some focus on partnerships with industry, while others focus on partnerships with communities and non-governmental organizations and still others concentrate on fundamental research questions. These areas build on Dalhousie's strong research foundation. They are studied from a number of theoretical and practical perspectives with a variety of methodologies and tools, thereby enhancing the depth and overall quality of the research enterprise. Many researchers find

their fit in several of these areas, revealing the broadly interactive and multidisciplinary nature of Dalhousie’s research landscape (see Appendix 2).

Priority Research Areas and Areas for Potential Growth

The four priority areas of research in which Dalhousie intends to distinguish itself are: Ocean Studies; Advanced Materials and Clean Technology; Health and Wellness; and Governance, Society and Culture. The three areas of emerging research strength are: Information Science and Communication; Agriculture and Food Technologies; and Energy and the Environment.

Dalhousie’s Priority Research Areas and Areas of Emerging Research Strength
Priority Research Areas
Ocean Studies
Advanced Materials and Clean Technology
Health and Wellness
Governance, Society and Culture
Areas of Emerging Research Strength
Information Science and Communication
Agriculture and Food Technologies
Energy and the Environment

Priority research areas and areas of emerging research strengths are developed through CRC and CFI opportunities, university centres and institutes, as well as endowed chairs and Industrial Research Chairs.

Dalhousie intends to:

- achieve national and international prominence as a leader in the identified priorities
- build excellence by achieving a critical mass of expertise in these areas
- align with national and regional research priorities (see Appendices 3 and 4)

1. Ocean Studies

Canada has the longest coastline in the world. The ocean is an integral part of our economy, culture, transportation and sustenance. Building on its broad range of expertise in oceans research and its proximity to the ocean, Dalhousie has established itself as a national leader in ocean research and is on its way to being defined as a world leader in this area.

Ocean studies at Dalhousie are interdisciplinary and are comprised of engineering, science, social science, law and public policy, management and international development activities. The area involves more than 100 researchers in six faculties and a wide array of disciplines, with numerous CRCs and a Canada Excellence Research Chair (CERC) committed to it. With its extensive network in areas of oceans education, research and outreach, Dalhousie is uniquely positioned to contribute solutions to many of the challenges facing the world's oceans and coasts.

Halifax Marine Research Institute

HMRI brings together university researchers, industries and government laboratories to increase the scale, quality, impact and internationalization of marine research in the region. It is also involved in delivering the Irving Shipbuilding contract's value proposition.

Several large-scale research initiatives headquartered at Dalhousie greatly enhance the university's strength in Ocean Studies: the Ocean Tracking Network (OTN); Canada Excellence Research Chair (CERC) in Ocean Science and Technology; the Network of Centres of Excellence in Marine Environmental Observation, Prediction and Response (MEOPAR); and the Halifax Marine Research Institute (HMRI). All of these research efforts are located in the new Dalhousie Ocean Sciences Building.

Ocean Studies has eight clusters: (1.1.) Marine Biological Resources and Conservation of Biodiversity; (1.2.) Marine Technologies; (1.3.) Ocean Environmental Processes; (1.4.) Arctic Studies; (1.5.) Ocean Law and Governance; (1.6.) Atmospheric Science; (1.7.) Marine Bio-Resources; and (1.8.) Marine Affairs.

Cluster 1.1. - Marine Biological Resources and Conservation of Biodiversity

Dalhousie is recognized internationally as a leader in research on the diversity and conservation of marine organisms, ranging from phytoplankton and zooplankton to large mammals including seals and whales. Research initiatives range from examining fundamental genetic diversity in the biochemistry and physiology of organisms, characterizing population dynamics, distribution and behaviour, and exploring the diversity of communities and ocean ecosystems locally and globally. Research in this cluster is enhanced by interdisciplinary strengths in landscape ecology, genetics, oceanography, economics, statistics and risk management.

Through the Platform for Ocean Knowledge Management, the Faculty of Computer Science in collaboration with the Ocean Tracking Network has developed the ability to analyze massive global ocean data sets, conduct experiments using models and visualize data and model results. Dalhousie's strength in this area is further exemplified by our involvement in the Canadian Healthy Oceans Strategic Network and the global Census of Marine Life.

Ocean Tracking Network

The Ocean Tracking Network is a global initiative headquartered at Dalhousie, which received over \$45 million from CFI, NSERC and SSHRC and has more than \$100 million in funding from international partners.

The network uses underwater acoustic receivers to track the migration of marine animals and is revolutionizing the way marine life is observed, modelled and ultimately understood. The data collected are accessed by researchers around the world.

A known threat to coastal ecosystems is the introduction of invasive organisms through purging of ballast water by shipping vessels. As global shipping is the most economically important ocean use, solutions to this challenge are needed. Ongoing experimental work at the Aquatron Laboratory, housed in the Dalhousie Ocean Sciences Building, allows the development of effective treatments that have global applications.

Dalhousie is known for its expertise in marine microbial genomics. The Marine Gene Probe Laboratory studies the genetics of population structuring, stock mixing and forensics, informed aquaculture development, live gene-banking for endangered populations and quantifying genetic biodiversity.

A significant strategic opportunity in the future is increasing integration of microbial oceanography/ecology and algal biotechnology.

Cluster 1.2. - Marine Technologies

Marine Technologies is an emerging cluster building on historic strengths across the university, from Oceanography to Engineering and Computer Science, with a renewed focus on the National Shipbuilding Procurement Strategy being carried out in Nova Scotia.

The university's research capacity in other marine technologies, such as high frequency broadband underwater acoustic techniques and wireless networks is well established. Research in the development of sensors and the autonomous platforms for their use is underway. Cooperation with industry relating to aquaculture and oil and gas is ongoing.

Cluster 1.3. - Ocean Environmental Processes

With more than 60 per cent of humans living close to a coastline, it is important to understand how global ocean change is impacting coastal ecosystems through warming, sea-level rise, acidification and changes in oxygen levels. Continuing changes in the environment and global interest in oil and gas extraction pose a high risk for negative impact on the ocean. Advanced research and observation to minimize future degradation of this valuable resource is essential. Dalhousie will continue to build on its existing expertise in Ocean Environmental Processes in: Marine Observation and Prediction; Environmental Statistics; and Earth System Evolution.

The CERC in Ocean Science and Technology studies the rapid changes in the North Atlantic as a result of human activity by measuring and evaluating carbon storage in the ocean.

Data assimilation and forecasting of the effects of predicted marine environmental change have the potential for future growth. Environmental Statistics contribute to and benefit from the CERC unit and HMRI and are also closely linked to university initiatives that improve the capacity and availability of high performance computing resources through networks such as the Atlantic Computational Excellence Network (ACEnet).

Marine Environmental Observation, Prediction and Response Network of Centres of Excellence (MEOPAR)
MEOPAR mobilizes the talent to evaluate, predict and respond to marine environmental risks and emergencies such as hurricanes, tsunamis, coastal flooding, oil spills and more, thereby reducing economic losses, societal hardships and environmental degradation.

Dalhousie participates in the Canadian Institute for Advanced Research (CIFAR) Earth System Evolution research program. Dalhousie's research strengths in geodynamics, tectonics, marine geophysics, surface processes and paleoceanography have important links with government and

private sector partners, for example in the assessment of offshore geological structures for oil and gas resources and in mapping the ocean floor and associated deep marine environments.

Cluster 1.4. - Arctic Studies

Current Arctic and subarctic research at Dalhousie includes studies of the ocean, atmosphere and terrestrial environment, such as examining the role of the Arctic Ocean in the global carbon budget, the mechanism and variability of deep water formation in the Labrador Sea and the composition of the Arctic atmosphere. As part of the Ocean Tracking Network, studies of the movement, ecology and interactions of fish and marine mammals are taking place in the Arctic.

In view of rapid environmental changes occurring in the Arctic, interest in the Arctic ecosystem and the effects of ocean and atmospheric processes will grow and expand in scope to include increased resource exploitation, commerce and security concerns. With the signing of the Memorandum of Understanding for collaborative research on Change, Risk and Resources: a TransAtlantic Arctic Approach with three of Germany's Helmholtz Institutes, the Arctic will become a growing focus of Dalhousie's oceans research.

Cluster 1.5. - Ocean Law and Governance

Dalhousie's Marine & Environmental Law Institute (MELAW) is a premier centre in ocean and environmental law with a global reputation. Our legal scholars have published highly regarded scholarly publications relating to law of the sea, international environmental law, Canadian environmental law and environmental assessment, energy law, ocean boundaries, biodiversity protection, fisheries, shipping, maritime security, maritime labour law and Arctic issues. The Ocean Yearbook, a leading periodical on ocean governance, is edited and produced by MELAW faculty, in cooperation with the International Ocean Institute. Research excellence has also been recognized by the allocation of a CRC devoted to encouraging interdisciplinary research and collaboration.

Coastal community health and public policy research at Dalhousie is diverse and encompasses research on ocean and coastal governance, new modalities for integrated coastal zone management and climate change adaptation. Under these broad themes, specific topic areas are being explored, including:

- consideration of impacts on people in coastal communities
- application of satellite and other new geographic information science
- analysis and management of risks to oceans

Cluster 1.6. - Atmospheric Science

Atmospheric science and ocean sciences are inextricably linked. Studying the atmosphere is relevant to many areas of human activity and human health. The atmosphere is highly mobile with strong interactions between regions of the globe; therefore research must be global to gain a complete picture. Advances in aerosol-cloud physics, severe weather and air quality studies also help researchers understand the changing atmosphere over Nova Scotia and Canada. Similarly, Arctic environmental conditions are a bellwether for the rest of Canada and Arctic research enhances our understanding of the earth's atmosphere.

Dalhousie's expertise in atmospheric science spans the Faculties of Science and Engineering. Our researchers work closely with Environment Canada, the Canadian Space Agency and Health Canada,

as well as with universities across the country and around the world. The strengths of our researchers lie in the construction and operation of measurement systems, particularly in extremely hostile environments, the interpretation of large datasets and the development of atmospheric models.

Cluster 1.7. - Marine Bio-Resources

Dalhousie is becoming increasingly involved in marine bio-resources in a number of ways. For instance, the university has used its multimillion dollar fresh- and salt-water aquaculture centre for finfish, shellfish and algal culture research. As part of the Genome Atlantic Camelina project, researchers are defining the nutritional requirements and identifying appropriate alternative diets for fish. Emerging aquaculture research areas include land-based finfish and shellfish production systems. Inter-institutional collaborations in aquaculture involve Memorial University, St. Francis Xavier University, the University of Prince Edward Island, Department of Fisheries and Oceans, National Research Council and local private sector partners. A burgeoning research area within sea-farming is aquaculture-environment interaction.

Dalhousie's development of marine bio-products, especially those derived from marine macro-algae studied for their impact on plant and animal production and health and the cell molecular basis of response is supported by local private sector research partners.

Cluster 1.8. - Marine Affairs

Human activities and their impact extend beyond coastal and economic zones affecting all coastal states in the world in both developed and less-developed countries. Effective marine management and the development of technical standards require an improved understanding of the ocean and new technologies for assessment and management of risks, opportunities and impacts. Dalhousie's Marine Affairs Program harnesses the university's breadth and depth of ocean-related expertise to offer Canada's only English-speaking Master of Marine Management degree and opportunities for interdisciplinary doctoral studies. Through this program, Dalhousie produces highly skilled marine managers capable of brokering knowledge among diverse disciplines, thereby advancing sustainable ocean use and healthy coastal environments.

The Marine Affairs Program is building its reputation as an integrated knowledge centre focusing on issues confronting Canada's Arctic, particularly the eastern Arctic. With the escalation of climate change impacts on the natural and human sub-systems in Canada's North, the need for science to inform policy in order to make wise and timely decisions is great. This strategic focus draws on Dalhousie's competitive advantage of having existing relevant expertise in the areas of law and policy, natural science, social science (including maritime security, indigenous knowledge and culture), coastal and ocean management, engineering, planning and architecture.

2. Advanced Materials and Clean Technology

"DREAMS"

The Institute for Research in Materials is home to DREAMS Dalhousie Research in Energy, Advanced Materials and Sustainability – program. The 1.65 million NSERC CREATE program supports research in renewable energy production and storage, as well as the sustainable production of environmentally acceptable or reusable materials.

Managing and developing new and renewable energy resources are global challenges. The need to better use the resources available to us is leading to innovations in how we use renewable resources, how we generate and store energy and how we make materials and material assemblies more energy efficient while minimizing their environmental impact.

Dalhousie is a national and international leader in advanced materials and clean technology research, with world-renowned researchers developing products that improve performance, productivity and efficiency while at the same time reducing costs, energy consumption and waste.

Materials and clean technology research at Dalhousie is interdisciplinary, engaging researchers from a number of faculties including Architecture and Planning, Science, Dentistry, Engineering and Medicine. Dalhousie has a number of CRCs and IRCs in this area, as well as an institute and two centres. The Institute for Research in Materials engages over 100 faculty members across the university in tackling major research and development projects in Materials Science and Engineering. This is an area where researchers have significant partnerships with private industry. The Centre for Innovation in Infrastructure is a focal point for research, innovation and technology transfer in sustainable civil infrastructure. The Centre for Water Resource Studies focuses on clean drinking water and water treatment technologies.

The five clusters in this priority research area: (2.1.) Clean Energy and Storage; (2.2.) Semiconductors; (2.3.) Environmentally Sustainable Materials and Clean Manufacturing; (2.4.) Sustainable Civil Infrastructure; and (2.5.) Water Management. In addition, materials research at Dalhousie University includes advancing fundamental understanding of the relationships between structure, properties, processing and performance of materials.

Cluster 2.1. - Clean Energy and Storage

Developing methods of providing and storing clean energy is crucial for the development of new environmentally neutral technologies. Dalhousie has several world-class research groups in the faculties of Science and Engineering studying the storage of electrical energy using batteries as well as other forms of energy via thermoelectrics, solar cells and phase change materials. It is also an area where there are significant private sector partnerships, including the Automotive Partnership Canada initiative.

Advanced batteries are used in electrified vehicles and electrical grid storage for renewable energy sources such as solar, wind and tidal power. Dalhousie's research in this area addresses safety, capacity, longevity and cost, through studying the

Automotive Partnership Canada

The Automotive Partnership Canada initiative bridges two clusters by providing funding for two projects at Dalhousie that will "build a better battery" and create ways for titanium to be more cost-effective in material use.

The aim is to increase the use of these new technologies in the automotive industry, thereby increasing energy storage capacity, reducing vehicle weight and improving fuel economy.

development of new materials, such as lithium-ion batteries and alternative battery chemistries. Dalhousie is home to the first Ultra High Precision Battery Charger in the world capable of measuring the difference between the charge stored and delivered by lithium-ion batteries of any size.

Cluster 2.2. - Semiconductors

Dalhousie researchers are using nano-sized pieces of semiconductor material to trap electrons. By harnessing electron spin, researchers at Dalhousie are laying the groundwork needed to build a quantum computer.

Researchers are also investigating interactions of light with semiconductors in order to gain control of individual photons. This will lead to new applications in high capacity information storage and high performance telecommunications.

Other researchers address a major disadvantage of solar energy production: the high capital cost of traditional photovoltaics. Cost effective solar cells could be a major advance in the development of renewable energy technologies. Dalhousie researchers are making progress in addressing the poor long-term stability and large internal resistance issues that must be solved to make organic solar cells commercially viable.

Cluster 2.3. - Environmentally Sustainable Materials and Clean Manufacturing

Governments worldwide are developing strategies to reduce greenhouse gas (GHG) emissions to mitigate global warming. Energy consumption in manufacturing and in the construction industry is a major contributor to GHG emissions.

Dalhousie's expertise, leadership and industrial partnerships in environmental issues and clean technology have local and global applications. Developing new materials and improving the performance of existing materials and their assemblies will help reduce the environmental impact of manufacturing and construction by using more durable materials that improve operating performance of products and minimize need for their replacement. Dalhousie's cutting-edge work has great potential to increase the competitiveness of Canadian automotive, aerospace and construction companies by reducing manufacturing costs while introducing manufacturing and application practices that use less energy and lead to lower material waste.

With the only Faculties of Engineering and Architecture and Planning in the region, Dalhousie's major research initiatives in advanced materials include the development of new materials in composites, metals, ceramics and coatings; and of construction assemblies designed to optimize environmental performance and minimize building energy use. Significant research is also undertaken on corrosion, tribology, additives, brazing and grinding, as well as energy harvesting and storage.

The Automotive Partnership Canada initiative supports research to increase the use of lightweight materials such as aluminum and titanium alloys in aerospace and automotive applications to reduce vehicle weight and improve fuel economy.

The development of corrosion resistant materials has applications that are important from an environmental standpoint. Corrosion resistant advanced materials are needed for tidal power generators and the marine industry. Dalhousie has significant strength in corrosion studies across faculties particularly in the understanding of pitting corrosion in stainless steels and the development of advanced corrosion resistant coatings.

The production of glass requires substantial amounts of energy and uses materials that are hazardous to the environment. Advanced glass research at Dalhousie focuses on the development of new glass that reduces environmental impact through enhanced durability and the use of materials that do not contain toxic elements such as lead. Glass that is stronger and less susceptible to breaking or clouding would minimize manufacturing and reduce the amount of energy required for production.

Cluster 2.4. - Sustainable Civil Infrastructure

Dalhousie is a world leader in evaluation, assessment and decision-making related to civil infrastructure. Researchers from several departments and the Centre for Innovation in Infrastructure collaborate with industry and governments to share their expertise, allowing for more knowledge-based management decisions. Researchers are advancing assessment techniques using structural health monitoring and non-destructive evaluation, developing higher performance materials such as fibre reinforced polymers and novel asphaltic materials, as well as improving the performance of structural systems by creating innovative products and designs that have longer service life and require less maintenance.

Cluster 2.5. - Water Management

Dalhousie's Centre for Water Resources Studies (CWRS) is a leader in addressing water issues locally, regionally, nationally and globally through applied research. Particular areas of focus include drinking water, wastewater, watersheds and geo-environmental issues. This research cluster has an IRC, CRCs and a CREATE Training program and researchers participate in Networks of Centres of Excellence and a wastewater research program in Nunavut. The Centre delivers value to its private-sector, non-profit and government partners through technical research projects, analytical laboratory support and training workshops.

3. Health and Wellness

Health and Wellness encompasses the activities of over 500 faculty members at Dalhousie and its affiliated teaching hospitals. This reflects the fact that health and wellness are prominent issues faced by government policy makers worldwide. An epidemic of physical inactivity and obesity, an aging population, increased concern for global health and global pandemics combined with unprecedented medical and technical advances, a greater emphasis on health promotion, primary care and disease prevention, and a focus on improved human function despite disruptive life events present a multidimensional research challenge. Dalhousie acknowledges the diversity of health research and the multifaceted nature of how health and disease impacts our population. The university is well positioned to address these challenges within a broad health framework.

Dalhousie is the major training centre in the Maritimes for life sciences, health professions and health law and policy research personnel. It is also home to the 'Faculty of Medicine of the Maritimes,' which offers a full complement of courses and degrees using innovative two-way remote infrastructure to allow students studying in Nova Scotia and New Brunswick to participate in the same lectures. Its contributions to shaping the delivery of services in Nova Scotia include collaboration on the Physicians Resource Plan and advising on cost saving measures for pharmaceuticals.

This priority research area clearly encompasses work done in the three Health Science Faculties of Medicine, Dentistry and Health Professions, but also includes research done in the Faculties of Architecture and Planning, Arts and Social Sciences, Computer Science, Engineering and Science, as

well as local health authorities in Nova Scotia and New Brunswick and provincial Departments of Health across Atlantic Canada.

The research undertaken by Dalhousie faculty members involves extensive collaboration with national programs including participation in a number of NCEs, Centres for Excellence in Commercialization and Research (CECR) and network initiatives supported by the federal granting agencies, the National Research Council (NRC), the Dalhousie Medical Research Foundation (DMRF), the Nova Scotia Health Research Foundation (NSHRF) and the industries in Nova Scotia's life science sector. Dalhousie has many CRCs, University Research Chairs, endowed chairs and centres and institutes in this priority research area.

Dalhousie will continue to emphasize and build capacity in health and wellness in four clusters, which have extensive interaction and interdependence: (3.1.) Biological Structures and Mechanisms; (3.2.) Medical Products, Vaccines and Technologies; (3.3.) Clinical Patient-Oriented Research and Translation to Health Outcomes, Services and Policy; (3.4.) Social, Cultural and Environmental Determinants of Health and Wellness; and (3.5.) Life Course Development. The university will also continue to support interdisciplinary research as evidenced by the Canadian Institutes for Health Research (CIHR) Training Program in Health Law, Ethics and Policy.

Cluster 3.1. - Biological Structures and Mechanisms

Understanding biological structures and mechanisms is essential to resolving many health complications. Dalhousie has significant expertise in this area particularly in relation to fundamental studies on the structure and function of proteins necessary for understanding disease processes and developing pharmaceutical agents; cancer, cardiovascular and stroke biology; comparative and microbial genomics; infection, immunity and inflammation; neuroscience; molecular modeling; and musculoskeletal health related to inactivity, obesity, stroke and arthritis.

Dalhousie's world renowned cancer researchers are studying cell biology processes related to the development and treatment of cancer. They are exploring strategies such as blocking cancer's progress by starving it of blood supply and killing cancer cells by manipulating its susceptibility to common viral infections. Research is also directed toward improved health systems and socio-behavioural aspects of cancer care and prevention.

Cancer

The Beatrice Hunter Cancer Research Institute provides leadership to facilitate and support research interactions within the Atlantic region through the Cancer Research Training Program (CRTP), endowed chairs, direct research funding and a comprehensive program supported by Canadian Institutes of Health Research, the Terry Fox Foundation, Cancer Care Nova Scotia and local cancer charities including the Nova Scotia Division of the Canadian Cancer Society and the Canadian Breast Cancer Foundation – Atlantic Region.

Dalhousie's cardiovascular and stroke research in basic and clinical sciences relates to biomolecular and inflammatory processes influencing atherogenesis, cell death related to ischemia, the physiology of heart function and the genesis of heart failure. The Cardiovascular Research Group brings together clinical and basic researchers to translate new findings to better care.

Genomics research crosses nearly all of the priority research areas, demonstrating its importance to modern science. Dalhousie is internationally recognized for its strength in microbial genomics, metagenomics and phylogenetic biodiversity based in the interdisciplinary Centre for Comparative

Orphan Genetic Diseases

The university is building on its existing capacity in human genetics and gene identification in relation to orphan genetic diseases with significant funding from Genome Canada. This research will impact on the treatment of cancer and disorders in areas such as vision and neuroscience. Genomic and genetic research is of great interest to researchers in bioethics and health law and policy as they examine the impact of such technologies on society and individuals.

Genomics and Evolutionary Biology and the Canadian Institute for Advanced Research program in Integrated Microbial Biodiversity. Large-scale sequencing projects in microbial genomics relate to human health; ocean sciences; aquaculture; forestry and agriculture; biotechnology and environmental remediation; and bioinformatics. The Faculty of Computer Science is developing expertise in handling the analysis of large databases through collaborative research initiatives.

Dalhousie has considerable research strength in infection, immunity and inflammation and response mechanisms in relation to chronic inflammatory diseases, tissue/organ transplantation, infectious diseases and cancer. This is an area with cross-cutting applications as major new developments have occurred that have assisted in vaccine development and testing for a variety of infectious agents. Further development in this area will be linked with developments in the study of the aging immune system, comparative and microbial genomics,

pharmacogenomics, viral research, cancer biology and biomedical engineering.

Fundamental research in neuroscience concerning neuroplasticity, neuroregulatory control of motion, behavior, vision and auditory sciences, as well as the elucidation of genetic defects in neurological function and mental dysfunction is an area of focus at Dalhousie. Research in this area, undertaken in the Brain Repair Centre, the Neuroscience Institute and the Atlantic Mobility Action Project, uses functional magnetic resonance imaging, stem cell biology and nerve regeneration to explore nerve function and repair. Dalhousie and the QEII Health Sciences Centre within Capital District Health Authority have major strength in basic research in neural function and regeneration. Researchers in Health Professions, Medicine and Biomedical Engineering also study underlying musculoskeletal processes with a focus on promoting health and identifying and treating injury, disorder and disease to enhance function, activity and participation.

Cluster 3.2. - Medical Products, Vaccines and Technologies

The development of medical products, devices and treatments is a particular area of expertise at Dalhousie. The interdisciplinary nature of the research is demonstrated in the many collaborations existing on and off campus.

Dalhousie has demonstrated excellence in the development of biomaterials and biomedical devices that enhance health care. This is evidenced by the development of better diagnostic tools, new devices for augmenting or replacing physiological function, improved therapeutic strategies and minimally invasive treatment options for eradicating or mitigating the impact of disease and materials for use in tissue regenerative strategies.

Vaccinology researchers at Dalhousie develop, implement and evaluate vaccine technologies and vaccines for

Biomaterials and Biomedical Devices

This interdisciplinary area engages the School of Biomedical Engineering, which is sited jointly with the Faculties of Engineering and Medicine and involves Dentistry and Health Professions. The Institute for Research in Materials also plays a significant role in Dalhousie's biomaterials research by coordinating multidisciplinary materials research efforts engaging researchers within and outside the university.

This research area is strengthened by significant operational, infrastructure and researcher support from the federal granting agencies, the Atlantic Canada Opportunities Agency, provincial research funding sources and industrial partnerships.

infectious diseases that have a significant impact on Canadian and global health. They have partnered with governments and industry to conduct clinical trials for over 20 years.

Dalhousie has significant capacity in this area, particularly in understanding fundamental structure and function of proteins and in the design, synthesis and evaluation of novel small molecules for treatment of a wide range of diseases, including neurological disorders, cancer and infectious diseases. This area has strong interdisciplinary links with neuroscience, cancer cell biology and infectious diseases.

Cluster 3.3. - Clinical Patient-Oriented Research and Translation to Health Outcomes, Services and Policy

Improving the delivery of primary health care and rehabilitation to enhance function as well as providing health care based on patient-oriented research and evidence are significant strengths at Dalhousie. Not only does this research impact health care delivery and policy, it also influences the training of the next generation of health care professionals. The majority of primary health care practitioners in our region are trained at Dalhousie. The health-related faculties have an increasing emphasis on research dealing with primary health care and continuity of care, with major initiatives in this cluster involving clinical trials, translational research, health outcomes, access to and structure of health services, population studies, law, the ethical concerns surrounding human subject research and health policy.

Comparative effectiveness research and health outcomes research at Dalhousie are integrated with initiatives across Maritime Canada as part of the national Strategy for Patient-Oriented Research (SPOR). The university's health faculties and affiliated hospitals have adopted a common goal of 'Discovery and Innovation for Health' with increased focus on primary health care, outcomes of health-care interventions, better delivery of health services and health policy. Emphasis is placed on research that informs policy makers as they collect and analyze health information and that catalyzes the development of health informatics to permit the effective evaluation of outcomes.

Mental Health Research

Dalhousie researchers, in collaboration with researchers at the Brain Repair Centre, are exploring the genetic and environmental causes of mental illness. They hope to find out if they can help predict effective treatment for individuals and identify the early stages of the development of mental illness to see if there are ways to treat it early to minimize impact. If successful, these interventions could help more people lead a fulfilled life without a future of mental illness.

These areas have multidisciplinary research groups comprised of clinicians, biomedical scientists and applied health and social sciences researchers working towards the development of better prevention and treatment, innovative medical technologies, effective nursing, pharmaceutical and rehabilitation interventions and improved models of care and emergency medical services.

Translational health research at Dalhousie is focused in several areas including mental health; developmental disorders; pain management; chronic inflammation and social determinants of health, health policy and health promotion.

Severe forms of mental illness, such as schizophrenia, bipolar disorder and severe depression, affect 1 in 20 individuals and are responsible for much personal and family suffering and significant economic strain world-wide. Dalhousie researchers conduct

important mental health research in both adult and child clinical settings and have developed innovative approaches to treatment and self-management.

Pain is one of the most difficult medical symptoms to treat, as each person’s experience with pain is unique. Dalhousie’s internationally renowned work on pain focuses on the development of better measures of pain and the efficient and effective delivery of services to treat pain. Dalhousie is the coordinating centre for several research networks relating to the control and treatment of chronic pain from accidents, cancer and degenerative diseases, end-of-life care, as well as the diagnosis, measurement and management of pain in infants and children, particularly the developmental, psychological and social influences on children's pain.

Chronic inflammatory diseases, such as arthritis, asthma and inflammatory bowel disease are an increasing societal burden. Dalhousie’s successful team of inflammation researchers is developing new approaches to prevention therapy and effective treatment delivery.

Cluster 3.4. – Social, Cultural and Environmental Determinants of Health and Wellness

Determinants of health and wellness of individuals and families, population health and health and social policy are areas of strength and emphasis at Dalhousie and the affiliated teaching hospitals. Research in determinants of health and wellness and health promotion at Dalhousie are interdisciplinary with many joint initiatives across the Faculties of Arts and Social Sciences, Agriculture, Computer Science, Health Professions, Dentistry, Law and Medicine, the affiliated teaching hospitals and community organizations. This collaborative work is illustrated by:

- Atlantic Aboriginal Health Research Program
- Resilience Research Centre
- Atlantic Health Promotion Research Centre
- Health Law Institute
- Gender and Health Promotion Studies Unit

Identifying and eradicating risk factors associated with poor health and wellbeing and promoting healthy lifestyles and environments to support optimal health and wellness help prevent disease and reduce the risk of its recurrence or exacerbation. Current initiatives at Dalhousie focus on improving rural health outcomes in stroke and cardiovascular disease and assessing environmental factors for diseases such as cancer. Health and Wellness in general benefits from and contributes to the emerging strength in Information Science and Communication. Work with administrative health data and pooled data from primary care practices’ electronic medical records provides a capacity to deal with primary health care issues.

Health law and policy research expertise at Dalhousie focuses on vulnerable populations and access to services. The evaluation of the effectiveness of the Cancer Care Nova Scotia-supported provincial approach to cancer care and the assessment of a patient navigation program have gained

Social Determinants of Health

Dalhousie has established trusted programs and resources that are used by the provincial government. The Applied Research Collaborations for Health program, for example, addresses issues of public health and obesity and the Atlantic Aboriginal Health Research Program explores the determinants of health and wellness of Aboriginal Nova Scotians.

Dalhousie houses many provincial administrative health databases including the Population Health Research Unit, the Perinatal Epidemiology Research Unit, the Research Methods Unit, the Canadian Longitudinal Study of Aging and the Atlantic node of the Canadian Aerosol Research Network. Dalhousie also houses Statistics Canada data at the Atlantic Regional Data Centre.

international attention. Other initiatives, such as the Initiative for Medication Management, Policy Analysis, Research and Training, provide substantial support to the government in developing effective drug use policies.

Cluster 3.5. – Life Course Development

Life Course Development

The Resilience Research Centre and the NCE on Children and Youth in Challenging Contexts addresses aspects of a young person’s family, neighbourhood, wider community, school and the political and economic forces that exert an influence on a child’s development in challenging contexts.

Understanding and addressing health and wellness concerns pertaining to children, youth, families, seniors and the elderly and the communities in which they live is an important area of research at Dalhousie. Clinical research is engaged across the full life-course from the unborn fetus to the frail, elderly patient, including end of life care. Clinical and community-based interventions, the promotion of health, social well-being and resiliency in the challenging circumstances of disease, the exploration of social disparities and vulnerability all factor into Life Course Development research. Developmental research of

infants and children focuses on language and literacy, sleep, physical, cognitive, mental and emotional development, family influences and the implications of disabilities on function and well-being across childhood.

Research collaborations in Life Course Development are formed across the Faculties of Health Professions, Medicine, Arts and Social Sciences, Science and Dentistry and build on strong linkages with the affiliated hospitals, local health authorities and continuing care facilities. One of Dalhousie’s strengths in this area is further demonstrated by named chairs, institutes and centres, the Child Soldiers’ Initiative and a Knowledge Mobilization Initiative Network for Children and Youth in Challenging Contexts. Research also focuses on the biological process of aging. Other strengths exist in research related to recovery, rehabilitation and clinical care of the elderly and aging population.

4. Governance, Society and Culture

Dalhousie University recognizes Government, Society and Culture as a priority research area. There are few aspects of social life that are ungoverned or unregulated; few that emerge without historical, institutional or philosophical impetus; and few that are manifested without cultural expression or mediation.

The interdisciplinary nature of this area engages the Faculties of Architecture and Planning, Arts and Social Sciences, Health Professions, Law, Management and Medicine. Governance, Society and Culture intersects with priorities identified by the Science, Technology and Innovation Council of Canada and the Social Sciences and Humanities Research Council of Canada, with particular respect to the regulation, ethical use and security of tangible and intangible resources in Canada and abroad, cultural and artistic aspects of new information and communications technologies tied to digitizing information and Canadian cultural products and research on indigenous peoples. Demonstrating Dalhousie’s strength in this area are a number of CRCs, University Research Chairs, endowed chairs and many centres and institutes.

Each of the university’s three main missions (teaching, research and community service) raise issues of governance and, in a world of increasing connectedness through globalization, the challenges and opportunities associated with effective and innovative governance strategies are becoming more

complex. Dalhousie is internationally recognized as a leader with strength in several related clusters, including (4.1.) Peace, Conflict Management, Mediation and Security; (4.2.) Ethics, Values and Expert Knowledge; (4.3.) Studies of Europe; (4.4.) Social Justice and Development; (4.5.) Cultural Studies, including Aboriginal and Migration Research; and (4.6.) Cultural Aspects of Digital and Social Media.

Cluster 4.1. – Peace, Conflict Management, Mediation and Security

Research on the nature and roots of violence and conflict, as well as world-leading initiatives to address child soldiers and children in conflict zones, are organized through the Centre for Foreign Policy Studies. The NCE-KM grant in support of Children and Youth in Challenging Contexts is the most recent measure of research excellence at Dalhousie on these important themes. Dalhousie has also long been recognized as Canada's leading centre for Maritime Security Policy research, through the work of the Centre for Foreign Policy Studies as well as the Marine & Environmental Law Institute and the Marine Affairs Program. This role is reflected in several ways, including long-standing links with the Royal Canadian Navy, the publication of the "Canadian Naval Review" and an extensive program of publications, conferences and workshops. Projects exploring various dimensions of conflict management and dispute resolution, crisis management, Canada-US security and trade relations, Arctic security/sovereignty, privacy and non-discrimination and global security demonstrate other important research strengths. These increasingly important policy issues are explored in the Faculties of Law and Arts and Social Sciences.

Cluster 4.2. – Ethics, Values and Expert Knowledge

Ethics, Values and Expert Knowledge includes research into the functioning of institutions and governance regimes focused on ecological sustainability and social responsibility; expert and scientific knowledge mobilization; ethical and value-led management; the ethics of international development assistance; and medical care. Many researchers are examining the practices of science with society and government and how they are shaped in parallel with shifting ethical concerns. Philosophers, lawyers, urban planners, social scientists, management professionals and health-care specialists are engaged in vital scholarship on the ethical dimensions of human interaction and the place of expert knowledge in these interactions.

A particularly strong node has developed around bioethics within the Novel Tech Ethics research team which is complemented by a strong node in health law and policy within Dalhousie's Health Law Institute. These groups and CRCs working in related areas are committed to the advancement of health law and policy and to the improvement of health care practice and health systems. By answering moral, ethical and legal questions surrounding health issues, progressive public policy can be mobilized for the benefit of all. Researchers have focused on issues that are central to Nova Scotia and Atlantic Canada, with attention to prescription drugs as a social problem, end of life care and health inequalities.

Cluster 4.3. – Studies of Europe

Work in this area proceeds under two headings. European Union Studies pertains to issues of governance and public policy such as trade relations, migration, health, environmental and energy security. Researchers in this area have been the catalyst for the development of the European Union Centre of Excellence and they continue to build on Dalhousie's research linkages with the European Union and other international bodies. European Studies pertains to culture, addressing communications, literature, film, music, philosophy, language and political events across the history

of Europe; this area is supported by the Centre for European Studies and is also furthered by research linkages with various European universities.

Cluster 4.4. – Social Justice and Development

Dalhousie is a leader in social justice, development and peace with interdisciplinary research pursued across faculties and critical approaches to gender, class, race, disability and sexuality explored in the humanities and social sciences. Work on peace and post-conflict reconciliation includes internationally-cited research on restorative justice, human rights and human security. This area intersects with the health and wellness priority, with significant projects in global and public health. Other work intersects with oceans, resource management, urban design and the environment, across various faculties such as Management, Arts and Social Sciences, Architecture and Planning and Law.

Dalhousie researchers have a strong tradition of working with non-government organizations, both locally and internationally. They have undertaken pioneering work with African Canadians and a number of Mi'kmaq communities and consulted international groups such as Human Rights Watch, among others.

Cluster 4.5. – Cultural Studies, including Aboriginal and Migration Research

Globalization requires us to understand how cultural practices impinge on issues of governance, transmit values and shape our reactions to change both at home and abroad. The study of literature, languages, performing arts, societies, institutions and cultural performance develops an understanding of other cultures, helping Canada to ensure a leading role in this new global society. Dalhousie researchers also study local cultures and migration, exploring why immigrants leave the region and how innovation can be sparked in coastal communities. Interdisciplinary projects with the Atlantic Metropolis Centre examine how to connect recent immigrants to urban design in Halifax and the contours of economic migration abroad. Immigration issues, and the related challenges of human rights and social justice, are vital to many parts of Canada, particularly in the context of a declining birth rate.

Dalhousie has unique expertise in aboriginal and indigenous studies and cultures. For example, researchers are working with the Atlantic Policy Congress of First Nations Chiefs Secretariat on collaborative projects for First Nations communities. Dalhousie's research involving Aboriginal Peoples within Canada and Indigenous Peoples worldwide have produced award-winning community planning and architectural projects with First Nations groups, work at the intersection of Indigenous Peoples' health, social justice and the environment and research examining the encounters of Aboriginal and Indigenous Peoples with nation states.

Cluster 4.6. – Cultural Aspects of Digital and Social Media

Examining the cultural aspects of new media and other information and communications technologies, as well as the digitization of information is an emerging area of research strength at Dalhousie. Work in this area ranges from cultural performance and artistic expression to the technologies that determine our ability to gather, share and use information. Attentive to knowledge mobilization and transfer in both their traditional and contemporary guises, it includes studies of media past and

present. It explores such things as the ways in which scientific knowledge is disseminated and received by its publics, the ways in which language mediates values and the technological innovations that will continue to shape our interactions with each other and the world around us.

VII. Areas of Emerging Research Strength

In addition to areas where Dalhousie has already built a strong research foundation and attained a level of recognition for excellence there are other areas that have demonstrated potential for significant growth. This Strategic Research Plan identifies three areas for potential growth: Information Science and Communication, Agriculture and Food Technologies and Energy and the Environment.

5. Information Science and Communication

Digital Humanities

The exponential growth and use of the internet has both enabled and required new applications and uses to be developed across sectors and sciences. *Editing Modernism in Canada (EMiC)*, an international, multi-million dollar collaboration between government, university and industry partners funded by the Social Sciences and Humanities Research Council, is leading the way in developing an integrated approach to text analysis, data mining and visual representation.

By coding references in texts, in an internationally consistent way, writings are becoming accessible to the next generation of humanities scholars and the public in a way never before thought possible, through searching keywords, tracing links, or visually representing content in terms of timelines, maps, charts, or graphs. This new approach has far reaching applications around the world.

Information and communication are central to social life and to our scientific endeavors. Information and communications technologies is a priority area of both the federal and provincial governments (see Appendices 3 and 4). Dalhousie has both a Faculty of Computer Science and a School of Information Management where researchers explore the boundaries of social media and data mining.

This potential area for growth builds on research being undertaken across the university, including work being done in the Faculties of Arts and Social Sciences, Computer Science, Engineering, Health Professions, Law, Management and Science. The applications of this work have an even broader interdisciplinary scope – reaching into almost every facet of society and possible area of study. There are CRCs working in three clusters within this area at Dalhousie: (5.1.) Computer and Wireless Information Networks; (5.2.) Information Systems; and (5.3.) New Media.

Cluster 5.1. - Computer and Wireless Information Networks

Computer and wireless information networks include broadband networks as well as wireless networks and services, which are two of the sub-priority themes of the Science, Technology and Innovation Council (STIC) report. Wireless network research areas include mobile computing, information transmission, processing and sensing networks, Radio Frequency Identification devices,

organic and nano-electronics, photonics and systems integration and tele-operation. An example of interdisciplinary cooperation and research is the use of this technology by the university's Ocean Tracking Network. With the growing use of such networks, security and privacy protection are becoming more important. Dalhousie's interdisciplinary research across a number of faculties is providing world-class solutions to global challenges.

Cluster 5.2. - Information Systems

The explosion of computing power, digital storage and digital communication through the internet and World Wide Web have revolutionized the way we work, pursue scientific discovery and technological innovation, communicate, socialize, shop and find entertainment. A by-product of this explosion is the accumulation of unprecedented amounts of digital data in the form of text, digital media and digital records of human activity. Dalhousie's existing expertise in information systems includes text mining, information retrieval and knowledge management. In particular, it involves dealing with the collection, use, analysis and interpretation of big data.

Research in this area involves the exploration of algorithms, data structures, high performance computing, analytics, computing architectures, cloud computing and web service architectures. Dalhousie houses very large ocean and health data sets. The central challenge in dealing with these large data sets is to turn data into information and information into knowledge. This process can be augmented through visualization techniques and GIS technologies that allow human cognitive processes to engage with the visualization of patterns in these massive data sets.

At the same time, emerging information technology presents new and challenging questions about use, ownership and regulation, testing traditional legal frameworks and challenging law and policy makers to keep pace.

Cluster 5.3. - New Media

New Media is a broad area that includes digital media, gaming, visualization, human-computer interaction and social media and networking. This is one of the sub-priority themes of the STIC report. New media has effectively changed the way people interact with each other and with computers and digital devices. However, the full impact of new media has not yet been realized as this technology is indeed new and continuing to evolve at a tremendous rate.

6. Agriculture and Food Technologies

The Faculty of Agriculture, formerly the Nova Scotia Agricultural College, is the only one of its kind in Atlantic Canada. The merger of the Nova Scotia Agricultural College with Dalhousie University in 2012, provided the infrastructure and knowledge required to undertake strategic initiatives to address the challenges of sustainable agricultural systems, food safety and security, economic trade and social policies and rural well-being. Existing collaborations among researchers, private industry, scientists at Agriculture Agri-Food Canada (AAFC) and other national and international research centres demonstrate the broad-based, interdisciplinary approach to agricultural and food research.

Research and teaching in environmental sciences, animal sciences, agronomy and horticulture is supported by:

- laboratories
- an experimental orchard
- greenhouse and growth chamber facilities
- a large-scale plant material drying facility
- a level II bio-security laboratory
- molecular biology facilities
- approximately 400 hectares of farm and field facilities
- modern dairy, sheep, fur and poultry research facilities

Through agreements with AAFC, Dalhousie researchers also have access to the Atlantic Food and Horticultural Research Centre in Kentville and the Nappan Research Farm.

With substantial existing expertise, Dalhousie has the potential to grow in three main areas of focus: (6.1.) Sustainable Agro-Ecosystems; (6.2.) Applied Molecular Biology, Genomics and Biotechnology; and (6.3.) Bio-Product and Bio-Resource Management. There are CRCs working in each of the three clusters in this area at Dalhousie.

Cluster 6.1. – Sustainable Agro-Ecosystems

Sustainable agro-ecosystems includes the study of climate change adaptation and mitigation, water and energy use, nutrient and waste management in agro-ecosystems, organic agriculture, plant and animal production systems and their impacts from soil to human health. Dalhousie's strength in this area is demonstrated by the Organic Agriculture Centre of Canada and the existence of a wide variety of industry partnerships.

Cluster 6.2. – Applied Molecular Biology, Genomics and Biotechnology

Applying the principles of molecular biology, genomics and bio-informatics to solve biological, agricultural and environmental problems is an area of growth for Dalhousie. The potential outcomes of this research include increased effectiveness in the generation of new knowledge related to environmental, agriculture and food issues and the development of new products arising from bio-resources.

Cluster 6.3. – Bio-Product and Bio-Resource Management

Bio-product development is emerging as a strong research area, with a particular emphasis on bio-products, human health and nutrition. This research focuses on product development for the poultry industry and on bio-product development for the blueberry and tree-fruit industries; however its applications could be much broader. The innovative research undertaken demonstrates expertise in plant and animal systems and will lead to the creation and development of novel technologies, processes or products that can be applied to food quality and safety, functional foods and nutraceuticals and novel bio-products.

Atlantic Centre for Agricultural Genomics

Through the Atlantic Centre for Agricultural Genomics, the Faculty of Agriculture has extensive CFI-funded infrastructure for molecular biology research and is the newest component of Dalhousie's strength in genomics.

The Atlantic Innovation Fund (AIF) has enabled the development of unique interdisciplinary partnerships between researchers and industry to address local problems such as mink Aleutian disease and to develop new products, such as feed supplements that enhance the nutritional value of milk products and new Christmas tree varieties that will stay fresh for longer periods of time.

7. Energy and the Environment

Energy and the Environment is an emerging research area at Dalhousie. Dalhousie has interdisciplinary strengths in non-renewable and sustainable energy, with the engagement of researchers in the Faculties of Architecture and Planning, Science, Engineering, Agriculture and Law. Dalhousie researchers contributed to, and remain engaged in, studies related to oil and gas, hydroelectric power and tidal power in the Bay of Fundy. These not only have significant economic impact on the region, but also have the potential for significant benefits to the people of Atlantic Canada.

Complementing the large group of researchers working on energy generation is Dalhousie's recognized world leadership in energy storage technologies, as well as burgeoning research in supply and demand side management and energy conservation. Three clusters of growing expertise in Energy and the Environment have been identified: (7.1.) Sustainable Energy; (7.2.) Non-Renewable Energy; and (7.3.) Reduction of Energy Use.

Cluster 7.1. – Sustainable Energy

The bulk of Dalhousie's energy research is focused on renewable energy sources such as biofuels, efficient use and management of biomass resources, wind, solar and tidal energy.

Cluster 7.2. – Non-Renewable Energy

Although clean technologies and environmentally sustainable resources are increasingly important, the world will continue to rely on non-renewable resources for many years to come. In the Faculties of Science and Engineering, Dalhousie has expertise in improving the effectiveness of exploration for and extraction of oil, gas and mineral resources, identifying a sustainable resource base and improving environmental practices in these areas.

Growth in Nova Scotia's offshore oil and gas industry has spawned a great deal of work on environmental, regulatory and policy research on offshore energy at Dalhousie.

Cluster 7.3. – Reduction of Energy Use

Ways to reduce energy demand and environmental impacts are also emerging research areas at Dalhousie. Researchers in the Faculties of Engineering, Architecture and Planning, Science and Management are focused on building new capacities for studying travel activities, transportation and emission modeling, sustainable transportation planning and for tracking progress in reduction of energy use and emissions. The potential outcomes of these multidisciplinary research areas include increased effectiveness in the generation of new knowledge related to long-term monitoring of travel choices, energy demand, emission exposure, sustainability issues and mitigation of environmental impacts.

VIII. Conclusion

The priorities outlined in this plan demonstrate the breadth and depth of Dalhousie's interdisciplinary research environment. Areas of research not included in the plan are also integral to the fabric of Dalhousie and make important contributions to society both at home and abroad. Using the Strategic Research Plan as a guide for investment and planning, Dalhousie will enhance its reputation as a research leader in the region and gain national and international recognition and success in the strategic areas. Dalhousie continually tracks its research performance against other Canadian universities to assess its progress in a national context and set goals for future growth.

Appendix 1 – Dalhousie University Canada Research Chairs by Priority Area

Dalhousie University Canada Research Chairs by Priority Area* ²			
Priority Area	Tier 1 CRCs	Tier 2 CRCs	Total CRCs
Ocean Studies	5	8	13
Advanced Materials & Clean Technology	2	6	8
Health & Wellness	5	12	17
Governance, Society & Culture	3	3	6
Areas of Emerging Research Strength	Tier 1 CRCs	Tier 2 CRCs	Total CRCs
Information Science & Communication	1	2	3
Agriculture & Food Technologies	0	3	3
Energy & the Environment	0	1	1
TOTAL	16	35	51

* Numbers as of April 2013

² The re-allocation of Chairs is undertaken by CRC every two years. The balance of Tier 1s and Tier 2s and the distribution of the Chairs by the Tri-Agencies (CIHR, NSERC, SSHRC) is reviewed annually by the University and every effort is made to adhere to the CRC allocation.

Appendix 2 – Interdisciplinarity of Research by Priority Area

Interdisciplinarity of Research & Application of Research by Priority Area							
Priority Area	Ocean Studies	Advanced Materials & Clean Technology	Health & Wellness	Governance, Society & Culture	Information Science & Communication	Agriculture & Food Technologies	Energy & the Environment
Ocean Studies	*	*	*	*	*	*	*
Advanced Materials & Clean Technology	*	*	*	*	*		*
Health & Wellness	*	*	*	*	*	*	
Governance, Society & Culture	*	*	*	*	*	*	*
Information Science & Communication	*	*	*	*	*		
Agriculture & Food Technologies	*		*	*		*	
Energy & the Environment	*	*		*			*

Appendix 3 - Federal Research Priorities

The Government of Canada’s Science, Technology and Innovation Council (STIC) has defined four research areas that are in the national interest from a social and economic perspective. As a result, federal research funding from the granting councils has been more directed to basic and applied research in these priority areas.

STIC Research Priorities and Sub-priorities	
Priority Areas	Sub-priority Themes
Environment	Water (health, energy and security)
	Cleaner methods of extracting, processing and utilizing hydrocarbon fuels, including reduced consumption of these fuels
Natural Resources and Energy	Energy production in the oil sands
	Arctic (resource production, climate change adaptation and monitoring)
	Biofuels, fuel cells and nuclear energy
Health and Life Sciences	Regenerative medicine
	Neuroscience
	Health in an aging population
	Biomedical engineering and medical technologies
Information and Communications Technologies	New media, animation and games
	Wireless networks and services
	Broadband networks
	Telecom Equipment

Appendix 4 - Provincial Research Priorities

The province of Nova Scotia has identified six priority areas as shown in the table below.

Nova Scotia's two main funding sources for research are the Nova Scotia Research and Innovation Trust (NSRIT), which is the mechanism for matching CFI funds and the Nova Scotia Health Research Foundation (NSHRF). Additional sources of research support are available from various provincial government departments and through organizations such as the Offshore Energy Research Association.

Province of Nova Scotia Research Priorities
Aerospace and Defence
Clean Technology
Financial Services
Information and Communications Technologies
Life Sciences
Oceans Technology