

Strategic Research Plan Summary for CFI/CRC/CERC

University of Alberta October 2016

INSTITUTIONAL OVERVIEW

In 2014-2015, the University of Alberta (U of A) was home to 38,733 undergraduate and graduate students, 551 postdoctoral fellows, 1,621 faculty members, 436 other academic staff, and 3,104 support staff. The institution has a wide variety of facilities that enable its work, and a few examples are highlighted here. The National Institute of Nanotechnology (NINT) is a strategic partnership with the National Research Council of Canada and the Province of Alberta. The University's health and wellness research complex includes the U of A Hospital (UAH) and affiliated buildings, the Stollery Children's Hospital (SCH), Li Ka Shing Centre for Health Research Innovation (housing the Li Ka Shing Virology Institute and the Li Ka Shing Applied Virology Institute and a GMP facility for cell and tissue production), the Alberta Diabetes Institute, the Edmonton Clinic Health Academy (ECHA), the Peter S Allen Magnetic Resonance Research Centre and the Mazankowski Alberta Heart Institute. Basic and translational oncology research is done in collaboration with the Cross Cancer Institute, which houses the Alberta Cancer Research Institute and the Edmonton PET Facility. The Glenrose Rehabilitation Hospital is a key partner for research in rehabilitation medicine. The Royal Alexandra Hospital (RAH) and the Lois Hole Hospital for Women are important collaborators in research related to women's and children's health, and the Women's and Children's Health Research Institute (WCHRI) recently received a gift of \$54.5M from the SCH Foundation and the RAH Foundation to support its work. Ingenuity Lab (the Nanotechnology Accelerator) is a partnership among Campus Alberta, NINT and the U of A focusing on groundbreaking bionanotechnology advances and innovative business practices. The nanoFAB is an open access micro- and nano-fabrication research facility with state-of-the-art fabrication capabilities and infrastructure that provides the equipment and expertise necessary for members of the nanotechnology community to achieve their research goals. The University's new Innovation Centre for Engineering was opened in 2015.

Beyond its five campuses, the U of A has an extensive set of holdings that support its research activities in a number of areas including: environmental sciences and ecology; rangeland ecology, land reclamation; water, food, plant, and livestock sciences; food safety; and land use management. These include the 2,248 hectare Kinsella Ranch; the 4,978 hectare Rangeland Research Institute; the 324 hectare St Albert Research Station; 148 hectares of experimental farms on South Campus; and the George Lake Research Site. The Oil Sands Tailings Research Facility near Edmonton supports substantial fundamental tailings research at a pilot scale and accommodates multiple, concurrent interdisciplinary research projects.

PLAN DEVELOPMENT

This is the U of A's October 2016 Strategic Research Plan (SRP) Summary for CFI/CRC/CERC, which is based on the U of A's 2016 Comprehensive Institutional Plan (CIP) prepared for the Government of Alberta. The CIP is aligned with various University vision and academic planning documents. It presents objectives and strategies for teaching, learning, and enrolment; research, scholarship, and creative activities; budget; and capital investment. Under President David Turpin, a new institutional strategic plan - For the Public Good - was launched in September 2016, and planning is currently underway to operationalize the plan.

PRINCIPLES AND OBJECTIVES

The U of A will continue to: (1) build on existing research strengths and develop emerging research strengths in ways that define a unique position for the University; (2) partner in innovative ways with the Provincial and Federal governments, the health care sector (with Alberta Health Services as a major partner), industry, and international collaborators; (3) foster trans-disciplinary interactions at all levels; (4) promote outstanding areas of special emphasis while maintaining the flexibility to respond to new opportunities; (5) maximize the benefits of research through effective knowledge translation and technology transfer; (6) expand graduate and undergraduate programs in support of our research strengths; and (7) invest strategically in innovation, technology commercialization and entrepreneurship activities across the institution.

COMPETITIVE AND WELL-MANAGED SHARED RESEARCH RESOURCES

Shared research resources support multiple agendas with cross-university and cross-sectoral partners. The U of A deploys CFI and CRC resources on strategic activities supported by these resources, which include:

1. NANUC - Canada's only open access nuclear imaging facility for discovery and industry research
Strategic areas supported: structural biology; new techniques and applications of ultra-high field NMR; structure and function of membrane proteins and large protein complexes; RNA processing; and drug discovery
2. Integrated metabolomics & genomics core
Strategic areas supported: translational biomarker discovery; virology, infectious diseases, chronic diseases; personalized diagnostics; advanced analytic and bioinformatics techniques and methods; forest and crop health; biomass by-product development
3. Environmental monitoring & molecular environmental analysis facilities
Strategic areas supported: wildlife management and disease monitoring; ecology; climate change; land use impact, biodiversity monitoring; environmental public health
4. Nanofabrication and advanced materials and surface sciences core
Strategic areas supported: nanoscience and nanotechnology for biomedical, personalized diagnostics, and natural resource applications; nanoscale molecular devices; nano-enabled biomaterials; renewable energy production; enhanced processes for fossil fuel production
5. Biomedical device fabrication and testing core
Strategic areas supported: rehabilitation devices; spinal cord injury rehabilitation; craniofacial prosthetics; health and wellness technologies
6. Cryosphere sample archiving and analysis
Strategic areas supported: geosciences; geochronology; earth history; climate change
7. Information infrastructure for digital social sciences and humanities
Strategic areas supported: history and classics; western Canadian history; demographic analysis; literary studies
8. MRI and PET centres (Peter S Allen Centre and Cross Cancer Institute)
Strategic areas supported: *in vivo* imaging of human diseases; improved diagnosis and treatments for cancer, cardiovascular disease, neuropsychiatric disorders and prion diseases; personalized diagnostics/precision medicine

The U of A has a number of institutional-level strategic initiatives that span multiple aspects of the University's mandate for research, scholarship, teaching and learning, and local/global impact. These include:

Integrated Water Innovation

Addressing various water challenges at the intersection of environmental health, public health, and food and energy production, with social sciences and cultural frameworks as crucial components.

Circumpolar and Northern Studies:

Promoting integrated social sciences, humanities, natural sciences, and engineering research on northern and circumpolar regions and societies, including social and cultural resilience and adaptation; impacts of arctic and subarctic environmental change; exploration and management of natural resources.

Aboriginal and First Nations Scholarship and Engagement

Cross disciplinary investment in faculty, programs, and joint appointments in nearly all areas of culture, history, language, education, health and wellness, policy, social and legal research related to, and with, Aboriginal and indigenous peoples.

Inter- and Intra-professional health training research

Cross cultural health and healing; primary care and rural health care; evidence-based best practices in health sciences team education, health professional collaborative practice; and the use of technology to support and enhance teaching and learning. Alberta Health and Alberta Health Services are key inter-sectoral partners. The University has also partnered with Alberta Innovates - Health Solutions (AIHS) to create new Translational Chairs in Primary Care, Waterborne Disease, Epigenetics and Cardiovascular Care.

DIVERSIFIED EXCELLENCE AND IMPACT

The U of A engages in research, scholarship, and creative activities across all domains of human endeavor. Key areas and investments are presented within seven thematic areas, with the number of current and planned proposals for CRCs and CERCs indicated. The University supports the maintenance of infrastructure for all these areas.

HUMANITIES AND FINE ARTS (CRC: 5 CURRENT)

Key theme areas: digital social sciences and humanities; cultural studies; Central and East European studies; East Asian studies and China Studies; comparative experimental linguistics; analytic and cultural philosophy; printmaking, design studies, drama, and music performance and ethnomusicology; literary theory; western Canadian history, culture, and languages; humanities and health systems; humanities and computer gaming; social and philosophical issues of contemporary biomedical technologies, eugenics, and mental disabilities; and classics, archaeology and anthropology.

Examples of strategic investment: The Cortona Italy School; Clifford E Lee Playwright-in-Residence; Canadian Literature Centre/Centre de littérature canadienne; Baikal Archaeology Project; Camrose Performing Arts Centre; Wirth Institute for Austrian and Central European Studies; Kule Institute for Advanced Studies; Canadian Centre for Ethnomusicology; Canadian Writing Research Collaboratory; the Timms Centre for the Arts; Smithsonian Folkways Alive!; and European Commission Centre of Excellence in European Union Studies.

SOCIETY AND CULTURE (CRC: 9 CURRENT)

Key theme areas: Education curriculum and pedagogy, measurement and assessment; integration of technology and science education; economic, legal, cultural and social impact of energy, natural resources, and environmental management and policy; health law and policy; retail management, entrepreneurship and family enterprise, institutional dynamics of markets, behavioural accounting, and corporate development; life-long learning; Francophonie, minority-language rights and legislation; and human rights, political economy and government studies.

Examples of strategic investment: Rupertsland Centre for Métis Research; Health Law Institute; Canadian Studies Institute/Institute d'études canadiennes; China Institute at the University of Alberta; Alberta Business Family Institute; Centre for Mathematics, Science, and Technology Education; The City-Region Studies Centre; Alberta Centre for Sustainable Rural Communities; Alberta Law Reform Institute; Campus Alberta Innovates Program (CAIP) Chair in Innovation Policy and Technology Translation; Technology Commercialization Centre; Aboriginal Health and Education Initiative; Population Research Lab; and Community Planning Program.

SCIENCE AND TECHNOLOGY (CRC: 35 CURRENT, 12 PLANNED; CERC: 1 CURRENT)

Key Theme Areas: Advanced materials and surface sciences; nanotechnology and nanosciences; all areas of chemistry, particularly carbohydrate sciences, analytic, organic, and physical chemistry; pure mathematics; space physics and plasma sciences; astronomy and astrophysics; condensed matter physics and low temperature quantum physics; subatomic and particle physics; theoretical physics and nanoscience; agricultural innovation; neuroscience, human cognition and cognitive development throughout the lifespan; earth evolution and systemics; high performance and distributed computing; computer games; computational intelligence and machine learning; data mining; telecommunications; remote sensing and wireless sensing networks; operation simulation; resource geophysics, geochemistry, and geochronology; geotechnical and geo-environmental engineering; image and signal processing; photonics and electromagnets; process control; informatics; microelectromechanical systems; dinosaur paleobiology, evolutionary development biology, evolutionary cell biology; genetics of vertebrate development; and mathematical biology.

Examples of strategic investment: Ingenuity Lab; NINT; nanoFAB; Alberta Glycomics Centre; Alberta Centre for Machine Learning; Canadian Centre for Isotopic Microanalysis; Centre for Mathematical Biology; Theoretical Physics Institute; Alberta Centre for Surface Engineering and Science; Centre for Particle Physics; Centre for Prions and Protein Folding Diseases; Edmonton Waste Management Centre of Excellence; 9 current NSERC Industrial Research Chair holders; IBM-Alberta Centre for Advanced Studies; and TEC Edmonton. The recently announced \$75M from CFREF for the University's Future Energy Systems Research Institute (FESRI) will add to investment in this area as well as the Energy area below.

ENERGY (CRC: 2 CURRENT; CERC: 1 CURRENT)

Key theme areas: resource geosciences, including seismic modeling and analysis; geophysics of mining and mineral processing; catalytic, interfacial and transport engineering, geotechnical and geo-environmental engineering; clean coal, oil sands and natural gas exploration, recovery, processing, with emphasis on mitigating environment impact; clean coal; carbon capture; alternate energy sources; renewable energy sources - photovoltaics, wind, geothermal, fuel cells, fusion; unconventional and shale gas and oil; mine waste technology; power systems and "smart grids" for distribution of renewable energy sources; the economics and business of energy restructuring policies and proposals;

environmental and land-use goals; environmental regulation on the development of clean pricing for oil, coal, and other fossil fuels; and economic and social impact of oil and gas, mining, agricultural, and other resource developments on indigenous peoples.

Examples of strategic investment: Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies (C⁵MPT); Institute for Oil Sands Innovation; Helmholtz-University of Alberta Initiatives; Oil Sands Tailings Research Facility; recruitment of CAIP chairs in Enhanced Geothermal Systems and in Interfacial Polymer Engineering for Oilsands Processing; and 13 current NSERC Industrial Research Chairs.

ENVIRONMENT (CRC: 6 CURRENT, 1 PLANNED)

Key theme areas: scientific, economic, policy and cultural issues associated with ecosystem and land management; biodiversity monitoring and assessment; forest entomology; wildland fire science; wildlife biology, management, health and disease, and conservation; land remediation; aquatic ecosystems; water resources engineering and environmental remediation; sustainable mining practices, equipment reliability for the resource sector, and sustainable building practices; energy efficiency in industry, buildings and transportation; rail and pipeline safety and integrity; water in its natural state (including wetlands, hydrogeology, river systems, glaciers, polar ice); northern ecology, climate change and arctic studies; groundwater safety and security required by rural and aboriginal communities; and earth observation and environmental monitoring sciences and technologies.

Examples of strategic investment: Nasser School of Building Science and Engineering; Canadian Rail Research Laboratory; Alberta Biodiversity Monitoring Institute; Edmonton Waste Management Centre of Excellence; Institute for Land Use Innovation; Centre for Earth Observation Sciences; recruitment of two CAIP research chairs in Integrated Watershed Management and in Aquatic Ecosystem Health; one current NSERC Industrial Research Chair; and recruitment of Alberta Innovates-Health Solutions Translational Chair in Waterborne Disease. Significant investment from NRCan and the U of A has led to the agreed transfer of the NRCan Ice Cores collection from Ottawa to Edmonton.

FOOD AND BIORESOURCES (CRC: 1 CURRENT)

Key theme areas: social, cultural, scientific, and technological innovation in food and the bio-economy; bioproducts, biomaterials, and bioenergy; nanoenabled bio-materials; value chain sustainability; sustainable livestock and crop practice; optimizing production and quality of traditional and new crop species; quality food for health; industry challenges and emerging opportunities; epigenetics, nutrition, and human health; socio-economic systems underlying agricultural economics, trade, marketing, and consumer behavior; sustainable rangelands and agriculture; and bovine genomics.

Examples of strategic investment: Biorefining Conversions Network; Livestock Gentec; Agri-Food Discovery Place; Alberta Poultry Research Centre; and recruitment of two CAIP Research Chairs in Nutrition, Food and Health and in Nutrition, Microbes and Gut Health.

HEALTH AND WELLNESS (CRC: 26 CURRENT, 5 PLANNED; CERC: 1 CURRENT)

Key theme areas: integrated health and wellness in all determinants of human health, including clinical factors and pre-dispositions and social and individual determinants of health; psychosocial behaviour research; membrane molecular biology/transport/lipids; cross-disciplinary research on chronic diseases, especially obesity and diabetes; transplantation sciences; rehabilitation medicine; cardiovascular development and regeneration; imaging sciences; infectious diseases and virology; neural rehabilitation and musculoskeletal research; craniofacial prosthetics; neuroscience, mental health and addictions; telehealth for diagnostics and collaboration; neuroendocrinology; nephrology and critical care; women's and children's health; diagnostics and medical devices; molecular medicine; protein structure and function; genomics, metabolomics and proteomics; precision medicine; public health and environmental epidemiology; virology and infectious disease; cross-cultural studies of health and healing; stuttering treatment and research; and pharmaceutical sciences, drug development and innovation.

Examples of Strategic Investment: Li Ka Shing Institute of Virology; IBM-Alberta Centre for Advanced Studies; Centre for Health Promotion Studies; Alberta Diabetes Institute; Women and Children's Health Research Institute; Northern Alberta Clinical Trials and Research Centre; Institute for Reconstructive Sciences in Medicine; CAIP research chair allocation in the Structural Biology of Protein Misfolding and Prion Diseases; recruitment of two Alberta Innovates-Health Solutions Translational Chairs in Epigenetics and in Community-Partnered Scholarship in

Primary Care; involvement in Strategic Clinical Networks (SCNs) within Alberta Health Services; evidence-based practice centre for the US Agency for Healthcare Research and Quality; Alberta Hub for Canadian Depression Research and Intervention Network (CDRIN); and funding for two institutional Translational Science Institutes: Cancer Research Institute of Northern Alberta (CRINA) and Neuroscience & Mental Health Institute (NMHI), both of which were approved by the Academic Planning Committee (APC), the University's most senior academic body.

NATIONAL PARTNERSHIPS

The University offers open access, national infrastructure in areas that include imaging (NANUC), advanced materials; digital humanities; and isotopic microanalysis. U of A is a founding or contributing member of a number of national initiatives that include the Banff International Research Station for Advanced Mathematics, Pacific Institute for Mathematics, SNOLAB, TRIUMF, Bamfield Marine Station, GlycoNet, WestGrid and Compute Canada initiatives, and the Canadian Light Source. The University participates in several partnerships with other Canadian universities related to international objectives, including IC-IMPACTS (India-Canada Centre for Innovative Multidisciplinary Partnership to Accelerate Transformation and Sustainability) with the University of Toronto and UBC, and CALDO, a consortium in partnership with Laval, Dalhousie, and Ottawa focusing on South America.

INTERNATIONALIZATION

The U of A focuses its international consortia in areas of institutional strength. International consortia partners include: Helmholtz Association of German Research Centres (energy and environment, neurodegenerative diseases and infectious diseases, expanding into earth observation sciences and terrestrial and ecosystem resource informatics, and diabetes); Ministry of Science and Technology (MOST) of China, and various Chinese universities (energy, water and public health); India IITs (all aspects of science and engineering, especially nanotechnology); World Universities Network (WUN); and Brazil (energy; remote sensing technologies for biodiversity). Active Memoranda of Understanding exist with the University of Oslo (space sciences), Ludwig Maximilians University (drama; computing science), Technical University of Munich (graduate school in engineering; computing science), Tsinghua University (energy), Fudan University (virology), Shantou University (neuroscience/mental health), and Jilin University (neuroscience/mental health).

ASSESSING SUCCESS

The University of Alberta has adopted a set of measures for assessing its progress on a number of institutional objectives relative to a select group of peer institutions. These include: availability of state-of-the-art facilities, including nationally and internationally shared facilities; recruitment and retention of outstanding faculty; prestigious national and international awards for faculty and trainees; research funding attracted on a competitive basis; diversity of funding organizations and partners; level of international funding; number of large-scale national and international research initiatives lead or partnered on; technology transfer and economic benefits through spin-off companies, and licensing activities.

CRC ALLOCATIONS AND DIVERSITY

The U of A has a commitment to gender and minority diversity, and underscores this in all internal correspondence related to CRC and CERC programs. It advises that all recruitment processes must be transparent, equitable, and consistent with the principles and safeguards embodied in the University's tenure-track hiring processes. The President's Advisory Committee on Senior Academic Appointments (PACSAA) reviews all applications with diversity in mind, and it is regularly provided with information on progress being made in this area.