

Strategic Research Plan Summary for CFI/CRC/CERC October 2019

The University's research and creative activities produce multiple societal impacts through the preparation of highly-qualified graduates and a continuous flow of innovation. The University attracts scholars of international reputation: undergraduate and graduate students, post-doctoral fellows, staff and faculty. Collectively, they foster, conduct and disseminate research and creative activity within and across all the major program areas at an internationally recognized level of excellence.

The University of Alberta is known for the breadth and depth of its strength. The University of Alberta ranked in the top 100 in four areas of Times Higher Education's newly expanded World University Rankings 2018 by subject (Education, 60th in the world; clinical and pre-clinical health, 77th; 83rd in law; and 99th in psychology). Those results follow on the heels of the QS World University Rankings by Subject 2017, which placed the University of Alberta in the top 100 in an unprecedented 25 subjects, including 10th in the world for sports-related subjects, 16th for nursing and 18th in mining engineering. We pursue diverse funding opportunities to support world-class research and scholarship, including partnerships with industries, organizations and communities to facilitate knowledge translation. In particular, we focus on enhancing equity, diversity, and inclusion in research and access to research opportunities for all scholars. TEC Edmonton, a joint venture with the Edmonton Economic Development Corporation which serves as the University's business accelerator, supports the commercialization of University of Alberta research and is ranked as one of the world's top university business incubators by UBI Global.

The Strategic Research Plan (SRP) for CFI/CRC/CERC, and this Strategic Research Plan Summary, are based on the University's 2019 Comprehensive Institutional Plan (CIP) which is prepared for the Government of Alberta. The CIP aligns 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, the institutional strategic plan - For the Public Good - was launched in September 2016 and a University-wide Equity, Diversity and Inclusion Strategic Plan was endorsed and launched in February 2019. Faculties also have important strategic plans that guide their research visions.

The University of Alberta will continue to follow these principles and objectives related to research:

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), the education sector (including Alberta Education and various public school boards), industry, significant community and nongovernmental organizations, and international collaborators;
3. Foster inter-disciplinary interactions at all levels;
4. Promote Signature Areas and other strategic areas of excellence 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 its research strengths;
7. Invest in innovation and knowledge mobilization for positive social and policy impact, technology commercialization and entrepreneurship activities across the institution;
8. Promote and nurture research environments that embody equity, diversity, and inclusion.

As an important feature of its institutional strategic plan, the University of Alberta has launched *Signature Areas of Research and Teaching* to strengthen broad-ranging and world-leading institutional excellence in a number of key

fields. Identifying and endorsing these Signature Areas allows the University to leverage existing areas of strength, incentivize additional collaboration with already world-class research in order to draw additional external funding and advance scholarship and discovery in these important areas. The Signature Areas include:

1. **Energy Systems** draws on the energy expertise, capacity and capability of more than 200 faculty members, across 23 departments and 10 faculties, making the University of Alberta the hub of a provincial, national and increasingly international cluster of companies, governmental organizations, Indigenous nations, communities, and universities working together to create energy-related collaborations and solutions. The University of Alberta is among the world's 10 top producers of energy systems research. With the establishment of the Energy Systems Signature Area and, prior to that, a major Canada First Research Excellence Fund (CFREF) \$75M award to support Future Energy Systems research, University of Alberta researchers are leading in areas ranging from energy technologies to research into the sustainable development of both fossil fuels and renewables, to research on land and water reclamation, to environmental law and policy, to the social and cultural dimensions of energy transitions.
2. **Intersections of Gender** draws on more than 250 academics across all 18 faculties at the University conducting gender-themed, interdisciplinary, and intersectional research. The University of Alberta is a leader in feminist intersectional research with efforts to apply an intersectional research lens to research questions and issues being tackled in a wide range of disciplines. The Intersections of Gender Signature Area is actively building important connections between complementary intersectional researchers and research agendas in fields that engage the experiences of Indigenous, LGBTQ+, disabled, and visible minority and racialized populations, while demanding critical analysis of social relations of power and privilege, social identity, and social inclusion.
3. **Precision Health** is an evolving health-care model that leverages data, new technologies, and the study of factors such as genomics, metabolomics, nutrition and environment, to better understand and address diseases and disabilities. Precision Health also includes the study of population data to deliver approaches to disease prevention, health promotion, rehabilitation, and reduction of health disparities in populations. Precision Health includes academics from all 18 Faculties at the University of Alberta and capitalizes on assets and infrastructure across the provincial health sector.
4. **Situated Knowledges: Indigenous Peoples and Place (SKIPP)** has been identified as an emerging Signature Area, building on research excellence related to Indigenous knowledges, Indigenous peoples and place. SKIPP seeks to assert and uphold Indigenous knowledges, support the resilience and resurgence of Indigenous peoples, and deeply understand the importance of place, at a University located on Treaty Six territory, working to respond to the TRC Calls to Action. Other important Indigenous initiatives, like the Wahkohtowin Lodge Indigenous Law and Governance Centre, co-led in the Faculties of Native Studies and Law, also showcase the growing strengths in and commitment to research and teaching in and with Indigenous communities.

The University of Alberta is a large, complex organization with 18 faculties, five campuses, 400 undergraduate programs, 500 graduate programs, 100+ institutes, and 800+ research/teaching/mobility agreements with more than 80 countries. Our researchers work in a wide variety of contexts, within an increasingly diverse city and province, as well as within many international contexts. Our areas of research and community engagement are also diverse; however, we highlight some in the following areas:

Humanities and Fine Arts

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; research-creation; 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; and the European Commission Centre of Excellence in European Union Studies; Intersections of Gender Signature Area.

Society and Culture

Key theme areas: Education curriculum and pedagogy, measurement and assessment; deaf education; integration of technology and science education; economic, legal, cultural and social impact of energy, natural resources, and environmental management and policy; feminist intersectional research; health law and policy; women and entrepreneurship; energy economics and regulatory policy; retail management, entrepreneurship and family enterprise, institutional dynamics of markets, behavioral accounting, and corporate development; life-long learning; disability and movement studies; 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; Western Canadian Centre for Deaf Studies; 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; Community Planning Program; and SKIPP Signature Area.

Science and Technology

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; artificial 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; Nanotechnology Initiative; nanoFAB; Alberta Glycomics Centre and GlycoNet NCE; new CERC in Glycomics; Alberta Centre for Machine Learning; Amii; 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; 9 current NSERC Industrial Research Chair holders; IBM-Alberta Centre for Advanced Studies; and TEC Edmonton. The \$75M CFREF award for the Future Energy Systems research program adds to investment in Science and Technology as well as Energy.

Energy

Key theme areas: resource geosciences, including seismic modeling and analysis; geophysics of mining and mineral processing; catalytic, interfacial and transport engineering; geo-technical and geo-environmental engineering; oil sands and natural gas exploration, recovery, and processing, with emphasis on mitigating environmental impact; clean coal; carbon capture, utilization, and storage; land and water reclamation; non-electric energy infrastructure; alternate

energy sources; renewable energy sources including photovoltaics, wind, geothermal, fuel cells, biofuels; power systems and smart grids for distribution of renewable energy sources; energy storage; economics and business of energy restructuring policies and proposals; environmental and land-use goals; community energy; environmental regulation on development of clean pricing for oil, coal, and other fossil fuels; economic and social impacts of oil and gas, mining, agricultural, and other resource developments on Indigenous peoples; energy humanities.

Examples of strategic investment: Future Energy Systems research program; Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies; Institute for Oil Sands Innovation; Geotechnical Research Experiment Facility; Oil Sands Tailings Research Facility; Future Smart Grid Technologies Lab; and Energy Systems Signature Area.

Environment

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 Indigenous 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; 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, CFI and the University of Alberta led to the transfer of the NRCan Ice Cores collection from Ottawa to Edmonton where they now constitute the Canadian Ice Cores Archive.

Food and Bioresources

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 ranchlands 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

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; stroke; 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; Mazankowski Alberta Heart Institute; the Institute for Reconstructive Sciences in Medicine (iRSM); 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); Precision Health Signature Area.

The University of Alberta focuses its international consortia in areas of institutional strength. International consortia partners include: Helmholtz Association of German Research Centres (energy and environment, infectious diseases, and diabetes); Ministry of Science and Technology of China, and various Chinese universities (engineering, science, arts and public health); India IITs (all aspects of science and engineering, especially nanotechnology) and Brazil (energy); Worldwide Universities Network; Worldwide Energy University Network. Active Memoranda of Understanding exist with the University of Oslo (space sciences), Ludwig Maximilians University (drama; computing science), Technical University of Munich (engineering, computing science), RWTH Aachen (science and engineering), Hunan Normal University (foreign languages and literature), Tsinghua University (energy and environment), East China Normal University (science and technology), Zhejiang University (medicine, food for health), and China Agricultural University (agriculture, genomics).

The University uses 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. A critically important measure of success is also the equity, diversity and inclusion represented across our research enterprise, as discussed below.

The University of Alberta is committed to equity, diversity and inclusion (EDI) and launched an EDI Strategic Plan in February 2019 that places formal accountabilities on all senior academic leaders (including the Vice-President Research and Innovation) and recognizes that achieving EDI goals requires responsible and accountable leadership and action at all levels and across the institution on an ongoing basis. We are a signatory to Dimensions Canada and have a robust CRC EDI Plan. All recruitment processes must be transparent, equitable, and consistent with the principles and safeguards embodied in our tenure-track hiring processes and in EDI best practices. The President's Advisory Committee on Senior Academic Appointments (PACSAA) reviews all applications with equity, diversity and inclusion in mind, and is regularly updated on progress in this area. The University's CRC-EDI committee is also attentive to all work done in this area, reporting to both the Vice-President (Research and Innovation) and the Provost and Vice-President (Academic).