UBC Applied Science Research and Partnerships

2022 Annual Report

THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Applied Science

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Message from the Associate Dean, Research and Industrial Partnerships, Faculty of Applied Science

Walter Mérida

"The world finds itself at the intersection of several global challenges. The breakthrough research conducted by APSC across both campuses is accelerating scalable solutions for a just transition to a net-zero future."

Economic resilience, job security, health-care delivery and supply chain integrity became strained during and after the COVID-19 pandemic. The floods, heat waves and wildfires in recent years have exposed the vulnerabilities of national and global economies under a changing climate. More recently, Russia's invasion of Ukraine highlighted the inescapable links between planetary health, energy security and geopolitical stability. While the scale and impact of these challenges are unprecedented, so are the opportunities to find viable solutions.

Canada is well-positioned to lead the transition to a low-carbon economy. Its competitive advantages include a stable financial system, channels to global investment, abundant natural resources and low-carbon electricity, and access to world-leading innovation ecosystems. For example, Canada hosts a vibrant biomedical sector working closely with academic institutions to drive innovation in imaging and computational biology, regenerative medicine and cutting-edge medical devices. These factors have enabled groundbreaking advances in diagnosis, treatment and patient care.

Canada also hosts more than 10 per cent of the world's top 100 clean technology companies, including leaders in hydrogen technologies, zero emission vehicles, electrolysis, water purification, carbon capture devices, synthetic fuels, nuclear fusion and quantum computing.

As the leading university on climate action, the University of British Columbia can support a just transition to a net-zero future. In this inaugural report, we highlight some of research initiatives in the Faculty of Applied Science (APSC).

APSC researchers are contributing to a better world, from the School of Nursing's focus on human health and well-being to the School of Community and Regional Planning and the School of Architecture and Landscape Architecture, which are developing scalable design, planning and engagement frameworks across cities, regions and communities. These nationally top-ranked schools are complemented by world-class expertise across seven engineering departments, including specialized knowledge at the School of Engineering at UBC Okanagan and the School of Biomedical Engineering in Vancouver (the latter being an example of effective and interdisciplinary partnerships across Faculties).

The Research and Partnerships team in APSC provides responsive assistance to support organic growth from historical and individual research initiatives that have characterized

our Faculty. To complement these efforts, we have initiated proactive approaches to develop scalable partnerships and research clusters.

As we look toward the future, and building on "Transforming Tomorrow" (the Faculty's Strategic Plan), we have developed research strategies under three priorities:

- Solutions for People
- Thriving Cities and Communities
- Planetary Health

The new strategies are supported by an expanded team under two functional structures (Development and Partnerships), additional support programs internal to APSC, improved outreach and engagement mechanisms, and internationalization efforts. All this work benefits from leading equity, diversity, inclusion, and indigeneity initiatives within the Faculty.

Building on the success of the Discovery Grant Bootcamp (in operation since 2017), APSC has developed new programs, including the Research Leadership Program, the Cluster Advancement Program, an NSERC Alliance Bootcamp and a streamlined SSHRC Institutional Grants program. The first new program aims to support our colleagues as they lead impactful research initiatives. The second augments the support from existing programs at UBC. The third aims to enhance our success rates in NSERC Alliance submissions and the last devotes resources to seed and expand research in the social sciences and humanities.

Our outreach and engagement mechanisms have been refined into repeatable processes that enable the co-creation of research objectives with regional, national and international partners. Through facilitated workshops, we can now identify challenges and opportunities that can be converted into long-term partnerships and high-impact collaborative research efforts.

A new approach to international partnerships recognizes the challenges of reactive engagement models and the scarcity of bi- or multilateral funding mechanisms in Canada. To address these challenges, and while continuing to manage a global research portfolio, we have focused on expanding our partnerships with Germany, the United Kingdom and the United States. Our focus has been informed by recent developments in policy alignment, legislative announcements, sectoral roadmaps, and more importantly, the availability of structured funding programs to activate the partnerships.

These strategies enhance APSC's innovation efforts, with nearly 300 patents issued for novel technologies, exemplifying our commitment the implementation of real-world environmental and economically sustainable innovations. Using our campus as a living laboratory and enabling new platforms to accelerate technology readiness, we have fostered an environment that attracts the industry investment that is critical for commercialization and localized economic development strategies.

Four of the world's top 25 start-up ecosystems are centred around Toronto, Vancouver, Montréal and Waterloo. One of them (the Cascadia Innovation Corridor) links British Columbia to Washington, Oregon and California. This corridor has a large population and a sizeable economy, an established immigration culture, one of the best airports in the world, the three largest ports on the continental West Coast, and leading higher education institutions. It is located in a time zone compatible with three financial centres (London, New York and Hong Kong), and it has achieved global brand recognition as the birth place of carbon taxes, Google, Boeing and Greenpeace. Our efforts to bridge the gap between academia, industry and government can link this vibrant ecosystem to groundbreaking discoveries and entrepreneurial ventures, as well as to the next generation of trailblazers.

These initiatives have yielded significant results, including doubling our research funding since 2017 (reaching $100 million per year in 2022), securing the highest proportion of industry funding at UBC (24% of total in 2022), reaching the highest success rates (90%) in NSERC Discovery Grant applications since statistics were collected (2022), and deriving half of our research publications from international collaborations (2022), bolstering our reputation and ability to compete on the global stage.

We look at the future with a deep sense of responsibility, but also with enthusiasm and optimism. Our approach to fostering interdisciplinary teams, integrative strategic partnerships and international collaboration has enhanced UBC's reputation on the global stage, and it has positioned our Faculty as a critical resource in Canada's research and innovation ecosystem.

I look forward to the next steps in this journey, and I am grateful for the opportunity to showcase the commitment, excellence and passion driving research and innovation in APSC.

Sincerely,

Dr. Walter Mérida, FCAE, PEng.
Associate Dean, Research and Industrial Partnerships
UBC Faculty of Applied Science

APSC STRATEGIC OBJECTIVES

From the APSC Strategic Plan **"Transforming Tomorrow"**

"Our core purpose is to discover, design and innovate; provide unwavering top-tier education; and champion a community of responsible professionals."

TRANSFORMING THE WORLD:

Solutions for People

Developing the health, technology and equity solutions that serve our communities and the individuals within them.

Thriving Cities and Communities

Improving how we move, work and connect to create healthier, safer and more productive communities.

Planetary Health

Spearheading efforts to accelerate global environmental action.

RESEARCH, INNOVATION AND PARTNERSHIPS ARE CENTRAL TO MANY OF THE 17 STRATEGIES

7 **Innovative spirit**
Create time and space for innovation.

11 **Entrepreneurial thinking**
Nurture the entrepreneurial mindset and venture creation to support innovative and transformational solutions.

12 **Impactful research**
Advance disciplinary knowledge and the translation of research and innovation for societal impact.

13 **Complex challenges**
Tackle complex local and global challenges with an interdisciplinary and systems-based approach.

14 **Strategic partnerships**
Collaborate with purpose in strategic, long-term partnerships.

OUR PEOPLE

5 Schools

- School of Architecture and Landscape Architecture
- School of Community and Regional Planning
- School of Nursing
- School of Biomedical Engineering
- School of Engineering (Okanagan)

6 Engineering Departments

- Chemical and Biological Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Materials Engineering
- Mechanical Engineering
- Mining Engineering

324 Tenured and tenure-stream faculty members and instructors

544 Staff

2,763 Graduate students

176 Postdoctoral research fellows

In January 2021, **115 researchers affiliated with the Faculty** were announced as among the

100,000 most-cited scientists across all scientific fields

and among the

TOP 2% most-cited scientists in their respective subfields

according to a database created by Stanford University

OUR FUNDING

+88%

increase in research funding over the past five years, compared to an 18% increase at UBC overall

+11%

increase in research funding between 2020-2021 and 2021-2022, compared to a 2% increase at UBC overall

$100M

in funding in 2021-2022, including $31 million from the Tri-Council and $19 million from industry

23 Canada Research Chairs

including three new chairs in 2021-2022, nine NSERC Industrial Research Chairs and one Canada Excellence Research Chair

OUR IMPACT

~9,000 Publications (2017-2022)

>130K citations
>280 patents

1,550 Publications (2021-2022)

>7,000 citations
130 patents filed
37 patents issued

TOP 1%

of papers and citations in topic areas spanning health care, information and communications technology, and clean energy

OVER 4,500 Publications (2017-2022)

(49% of total) resulting from **international collaboration** and over 1,600 (18%) resulting from **national collaboration**

NEARLY 800

instances of media coverage across newspapers, radio, TV and online (May 2021 – May 2022)

79

opinion pieces published by our researchers and students (May 2021 – May 2022)

Our Strategies: Impactful Research and Complex Challenges

Leveraging our strengths across diverse fields, APSC researchers excel in large, multidisciplinary projects that produce **impactful research**, tackling the **complex challenges** of our time — climate action, alternative energy and long-considered intractable health conditions (see the story on our "Mend the Gap" project on the following page). The Faculty is increasingly successful at attracting funding across all sectors, as well as **diversifying** our funding sources (Figure 1). While we remain competitive with Tri-council grants, we have also seen significant increases in **funding from industry** (84%) and **non-profits** (80%) over the past five years (2017-2022).

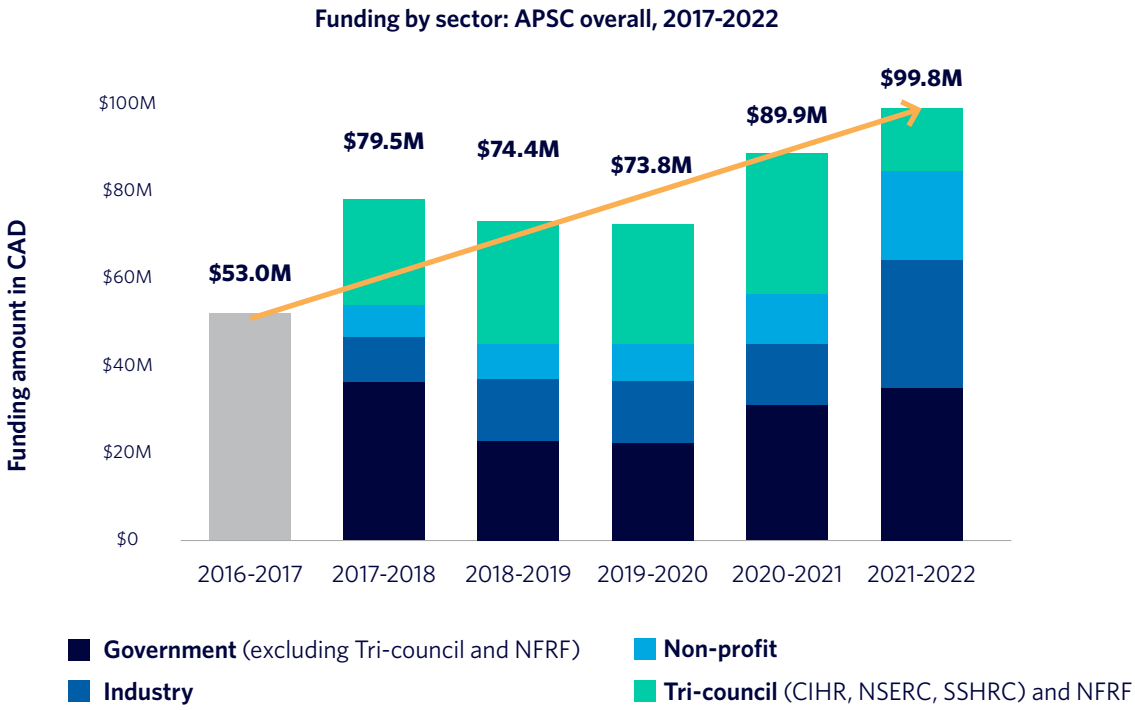
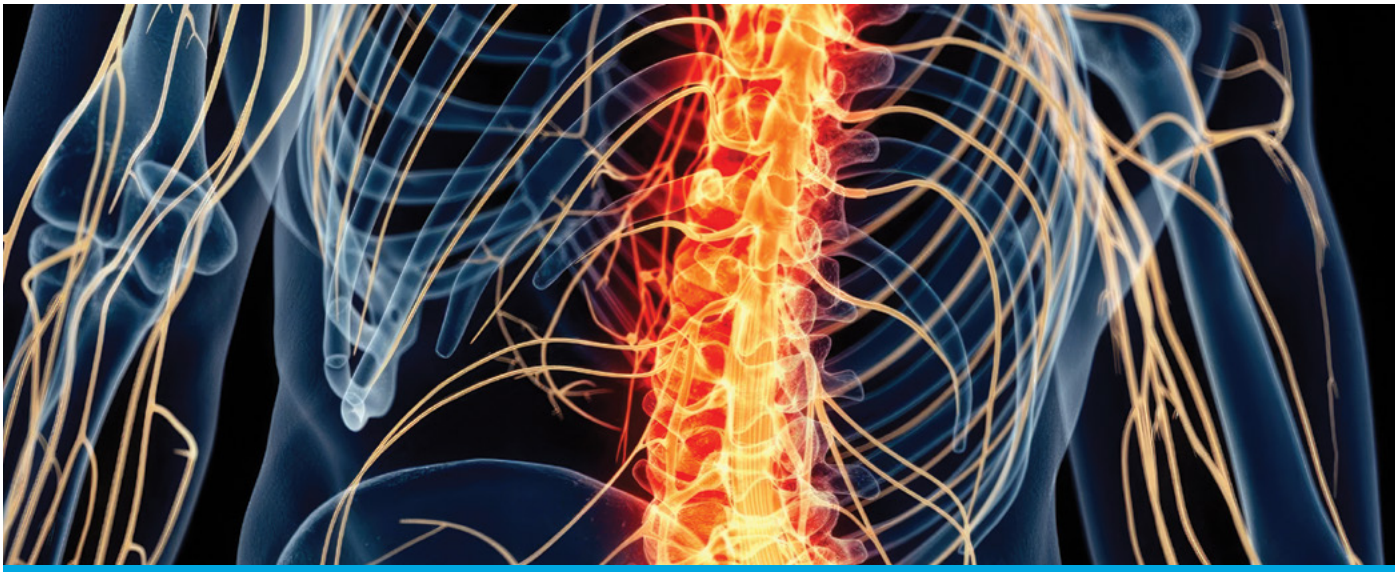


***Figure 1** – Overall research funding amount across APSC Vancouver & Okanagan campuses, 2016-2022.*

COVID-19

While the effects of the COVID-19 pandemic were felt globally and certainly across the Canadian funding landscape, our Faculty's resilience, well-developed 'Restart Research' plan and significant contributions to COVID-19 research – led by the **School of Nursing** (SoN) – put APSC in a strong position, increasing our funding by **35% since 2019**.

Data obtained from UBC's RISE system. Organized by fiscal year (e.g., 2017-2018 = April 2017 to March 2018 = Grant Year 2018). Tri-council = NSERC, CIHR, SSHRC. Industry = for-profit organizations. Okanagan campus = School of Engineering (SoE).



COMPLEX CHALLENGES

Mend the Gap

APSC researchers have been awarded a **$24 million** project to treat spinal cord injury. Research funded by Canada's New Frontiers in Research Fund — Transformation Stream will develop biomaterials, particularly soft gels, to 'mend the gap' of the injured spine for those with spinal cord injury and aims to reconnect the nervous system to prevent debilitating health symptoms.

The project is led by Dr. John Madden, Professor in Electrical and Computer Engineering, and unites a truly multi- and transdisciplinary team of over 30 scientists, clinicians, engineers and spinal cord injury stakeholders across five countries. As Dr. Madden states: *"Our international team ... aims to demonstrate regeneration. The unprecedented diversity of expertise of the team allows us to simultaneously address the many challenges by bringing to bear methods in neurobiology, ethics, robotic surgery, materials chemistry, imaging and rehabilitation."* The potential impact of this work cannot be overstated for the millions of spinal cord injury sufferers across Canada and worldwide.

The Research and Partnerships team worked extensively with Mend the Gap researchers and staff across APSC and beyond through consultations, partnership development, budgeting and proposal review. This was truly a collaborative effort and we are honoured to be part of this incredible project.

APSC receives funding from diverse sources, again highlighting the Faculty's strengths in addressing **complex challenges** of interest to a range of funders and partners across society and industry. APSC receives funding amounts of over $1.0 million each from **30 programs** as well as receiving funding from **100+** other sources (Figure 2). **The top three funding sources are**:

- **NSERC Discovery Grants ($37.1 million)**: the Faculty enjoyed a **success rate of >90%** in the 2021-2022 competition, the highest since data became available (2015)
- **Canada Foundation for Innovation John R. Evans Leaders Fund (JELF) and Innovation Fund (IF) ($25.8 million)** and matching provincial funding through the BC Knowledge Development Fund
- **NSERC Alliance program**: APSC has achieved the highest success rates (60%), share of applications (62%) and funding ($7.2 million) across UBC since the program was launched in 2019 (Figure 2, inset), showcasing our alignment with the key strategies of innovative spirit, strategic partnership and entrepreneurial thinking

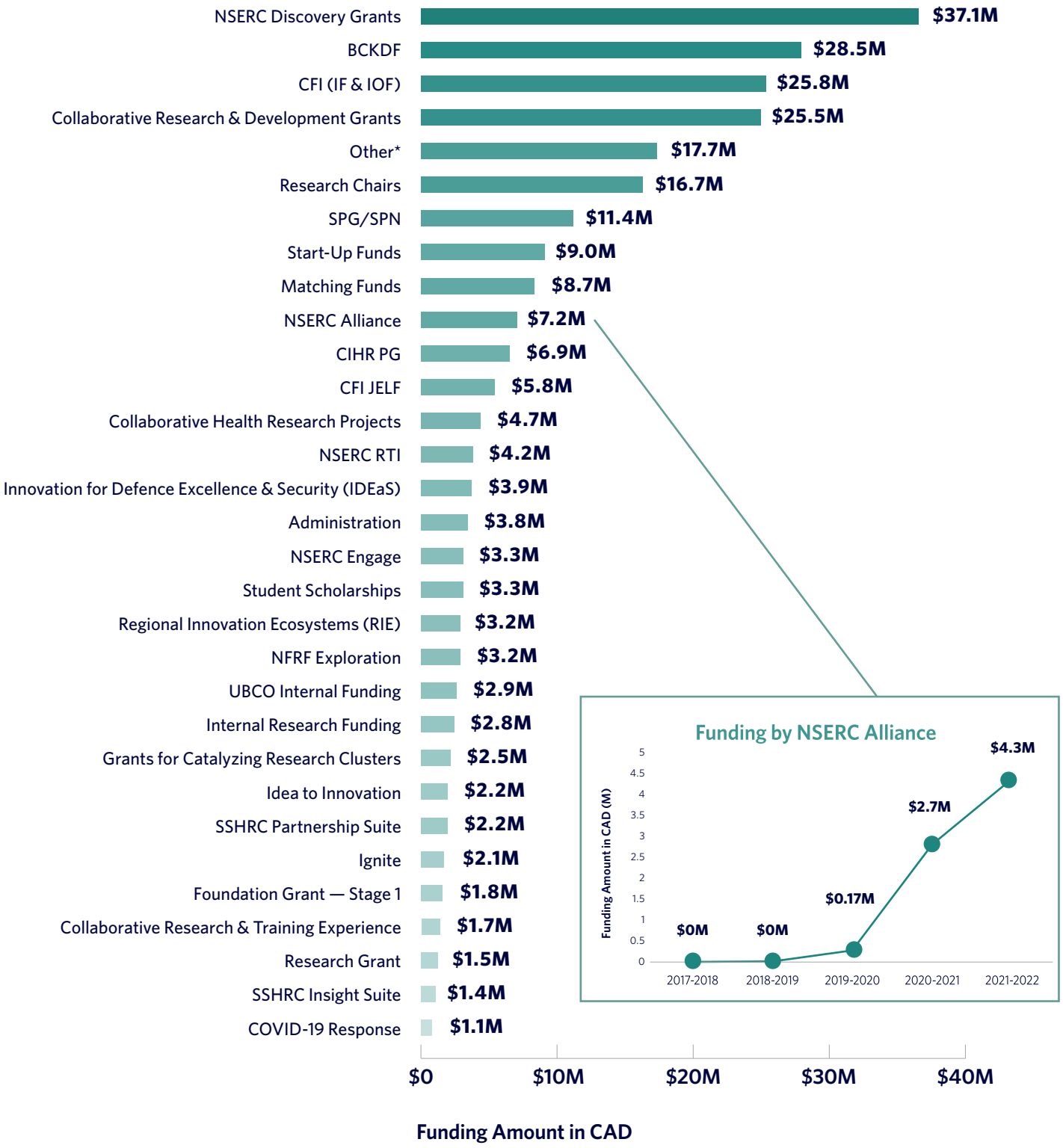


Figure 2 *– Funding programs with a total funding amount >$1.0M for APSC Vancouver and Okanagan campuses (2017-2022). Other = 100+ programs with total funding amount <$1.0M (e.g., Connect, Catalyst grants) over the time period.*

COMPLEX CHALLENGES

Alliance Grants

Carrying on the success enjoyed in NSERC's previous suite of partnership programs, APSC researchers lead UBC in the submission and awarding of Alliance Grants, **with over $7 million** in projects funded since the program launched in 2019. Our researchers have been successful in all streams of the Alliance program, from high-value, industry-relevant Option 1 consortia; small, yet societally urgent community-based projects under Option 2; and international special calls in strategic areas such as quantum technologies.

Recent highlights include:

- **Dr Jian Liu, UBC Okanagan School of Engineering + Fenix Technologies: $2.2 million total project** *(Option 1)*
- **Dr Christine Chen, Electrical and Computer Engineering + Vard Marine & Vard Electro Canada: $1.3 million total project** *(Option 1)*
- **Dr Carlos Molina Hutt, Civil Engineering + TransLink: $0.2 million total project** *(Option 2)*

Funding facts

Tri-council funding within the Faculty is significantly dominated by **NSERC**, followed by **CIHR** and then **SSHRC**.[1] Electrical & Computer Engineering captured the largest share of NSERC funding (**$31.9 million**), while the School of Nursing captured the largest share of both CIHR (**$7.1 million**) and SSHRC (**$2.8 million**) funding.[2]

The number of grants awarded to the Faculty has risen significantly since 2017 (**20%**), with a slight dip in 2021 (Figure 3). Considering the increase in faculty members (a **39%** increase, up to **324**) over this time period, this suggests faculty are aiming for – and achieving – larger, more lucrative grants, **a key priority for APSC.**

APSC captured ~11% of UBC's **total** funding in 2021-2022, and nearly **24%** of the university's **industry** funding.

APSC is closing the funding and success rate gap with the Faculty of Science; previously capturing ~55% of the Faculty of Science's funding amount in 2016-2017, compared to 73% in 2021-2022.

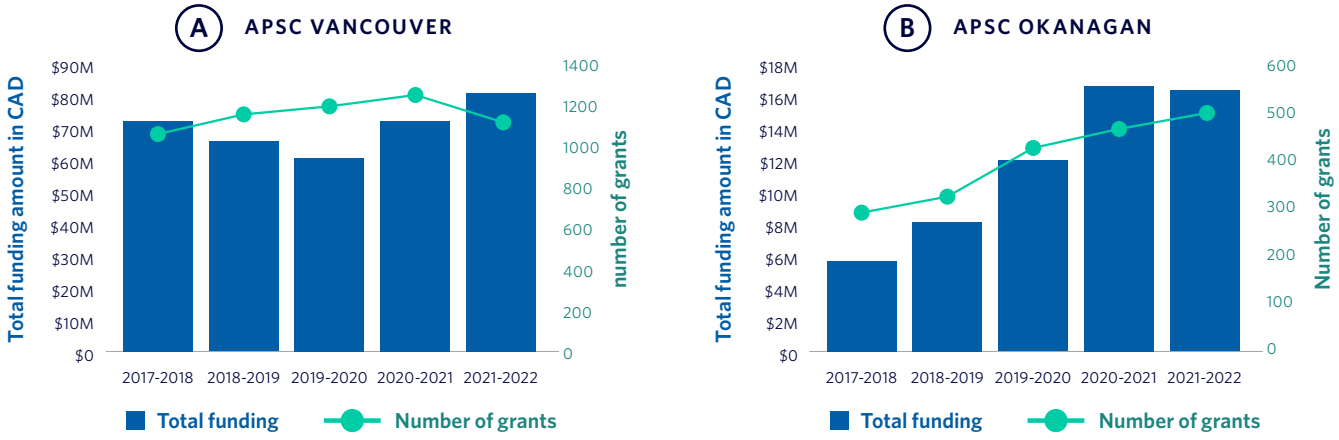


Figure 3 *– Total funding amount (blue bars) and number of grants (green line) across APSC Vancouver and Okanagan campuses (2017-2022). Total funding = sum of funding from government (non Tri-council and NFRF), industry, non-profit and Tri-council (CIHR, NSERC and SSHRC).*

[1] While administered by SSHRC, funding under this category does not include the NFRF program, which has only existed since 2018 and is considered separately.

[2] The School of Biomedical Engineering also successfully competes in SSHRC and CIHR funding; however, their grants are usually captured by the Faculty of Medicine, which co-administers the School.

Impactful Research: Infrastructure

In 2016, after a period of unsuccessful applications to Canada's largest infrastructure program, the CFI Innovation Fund (IF), the then brand-new Research Development team at APSC, under the leadership of Dean James Olson, **designed and implemented a robust, comprehensive support process for this program**. Combined with buy-in and truly innovative projects from our leading researchers, this new strategic approach led to **considerable success in the 2017 competition**, with $26.5 million being awarded in total research infrastructure funding to support major initiatives at APSC *(see the description of the Smart Hydrogen Energy District on the next page for one example)*.

The Faculty has continued to enjoy success at the CFI, including the JELF programs (**$5.8 million in funding, >95% success rate since 2017**), special calls, and the IF (Figure 4). We eagerly await the results of the 2022 call, in which **APSC submitted ~$19 million in applications to the CFI** (representing ~$45 million in total project costs, our highest to date).

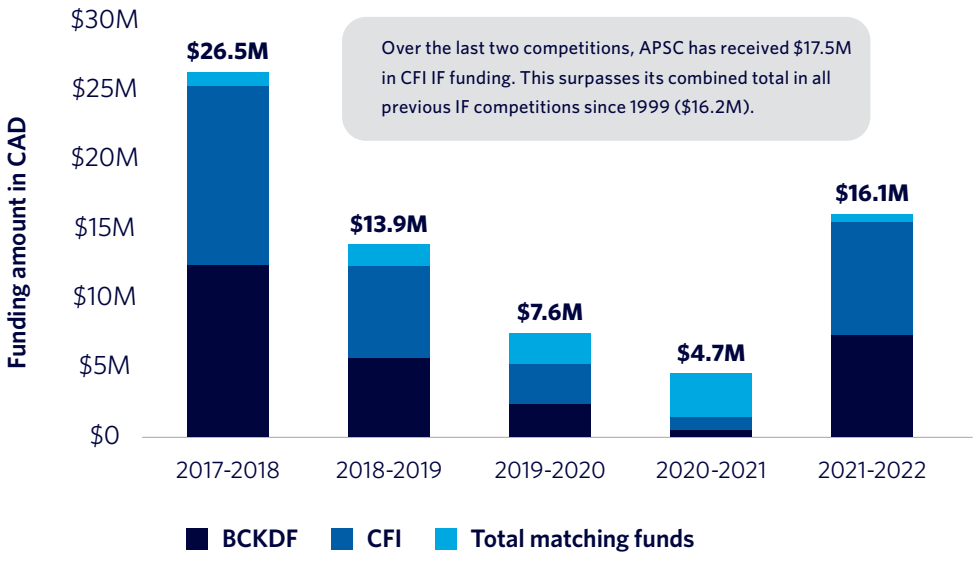


***Figure 4** – CFI funding across APSC Vancouver & Okanagan campuses (2017-2022). CFI = IOF, IF, Innovation Projects, JELF, JELF-Partnerships and the (defunct) Leading Edge Fund. Matching funds = Government (Canadian and US), industry and UBC internal funding. Note total project is ~2.5x CFI portion.*

IMPACTFUL RESEARCH

Smart Hydrogen Energy District

A groundbreaking **$25 million** renewable energy hub has started construction at UBC. The project, led by Dr. Walter Mérida, Professor of Mechanical Engineering and APSC Associate Dean of Research and Industrial Partnerships, will explore the integration of renewable energy, transport, intelligent telecommunication and urban assets in a city-scale testbed as a living laboratory, including BC's first-ever green hydrogen refuelling station for light and heavy-duty vehicles. The project will enable breakthroughs in renewable energy penetration for relevant economic sectors, and result in new business models for vehicle owners, cities and utilities.

To support the project, $6 million (in today's market) worth of low-carbon fuel standard credits were obtained from the BC Ministry of Energy, Mines and Low Carbon Innovation, with the following statement from **Minister Bruce Ralston**: *"In order to realize our CleanBC climate goals, we must invest in innovative energy solutions, like UBC's renewable energy hub. BC is well-positioned to become a world leader in clean energy, and this project demonstrates the excellent potential right here in the Lower Mainland."* The balance of funding was secured from a number of sources, including CFI, NRCan and industry partners, in what represents not just APSC's, but one of UBC's, most ambitious projects in sustainable development.

The Research and Partnerships team provides extensive support for CFI programs, and we are excited to expand our capacity to do so by welcoming Ms. Meisan Brown-Lum, Research Development Associate, to the team in January 2023. She brings over 10 years of grants experience, including more than five primarily focused on the CFI.

Impactful Research: Research Chairs

Over the last five years, APSC has increased its number of **Canada Research Chairs (CRC)** from 14 to 23, highlighting the exceptional ability of the Faculty's researchers and its increasing share of Tri-council funding. **New CRCs in 2021-2022 are highlighted below**. APSC boasts a **100% success rate on CRC awards since 2016**, and is proud to host chairs across all three councils and in all of our departments and schools. 2022 highlights included the submission of the **School of Engineering's first T1 Chair** and the submission of **two Canada Excellence Research Chair** applications in key areas for the faculty: disaster resiliency and bioengineering related to neurology and spinal cord injury. In collaboration with the Provost's office, APSC is working diligently to recruit top-level academics while meeting our equity, diversity and inclusion (EDI) targets, and we are represented on the Provost's EDI in CRC working group. We are expecting a busy year in 2023 with the largest cohort of renewals and new applications ever in the Faculty.

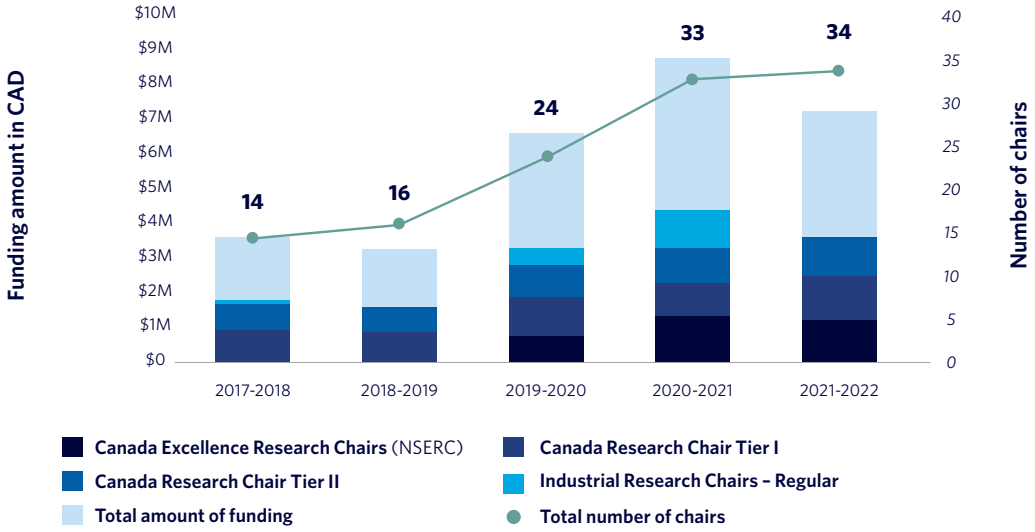


Figure 5 *– Research chairs funding (columns) and number of awards (green line) across APSC Vancouver and Okanagan campuses (2017-2022). APSC currently holds 23 CRCs among 34 research chairs in total.*

IMPACTFUL RESEARCH

New Canada Research Chairs in 2021-2022

Dr. Julia Harten, Assistant Professor, SCARP

CRC T2 in Data Innovation for Housing and Inclusive Urbanization

Priority area: **Thriving Cities and Communities**

Dr. Emily Jenkins, Associate Professor, Nursing

CRC T2 in Socioecological Approaches to Mental Health and Substance Use

Priority area: **Solutions for People**

Dr. Olivia di Matteo, Assistant Professor, ECE

CRC T2 in Quantum Software and Algorithms

Priority area: **Solutions for People**

The Research and Partnerships team, in particular Dr. Joanne Moszynski, Senior Manager of Research Development, has been actively supporting CRC applicants since 2016. Our services have been widely acknowledged at APSC as well as across other Faculties as among the best at UBC.

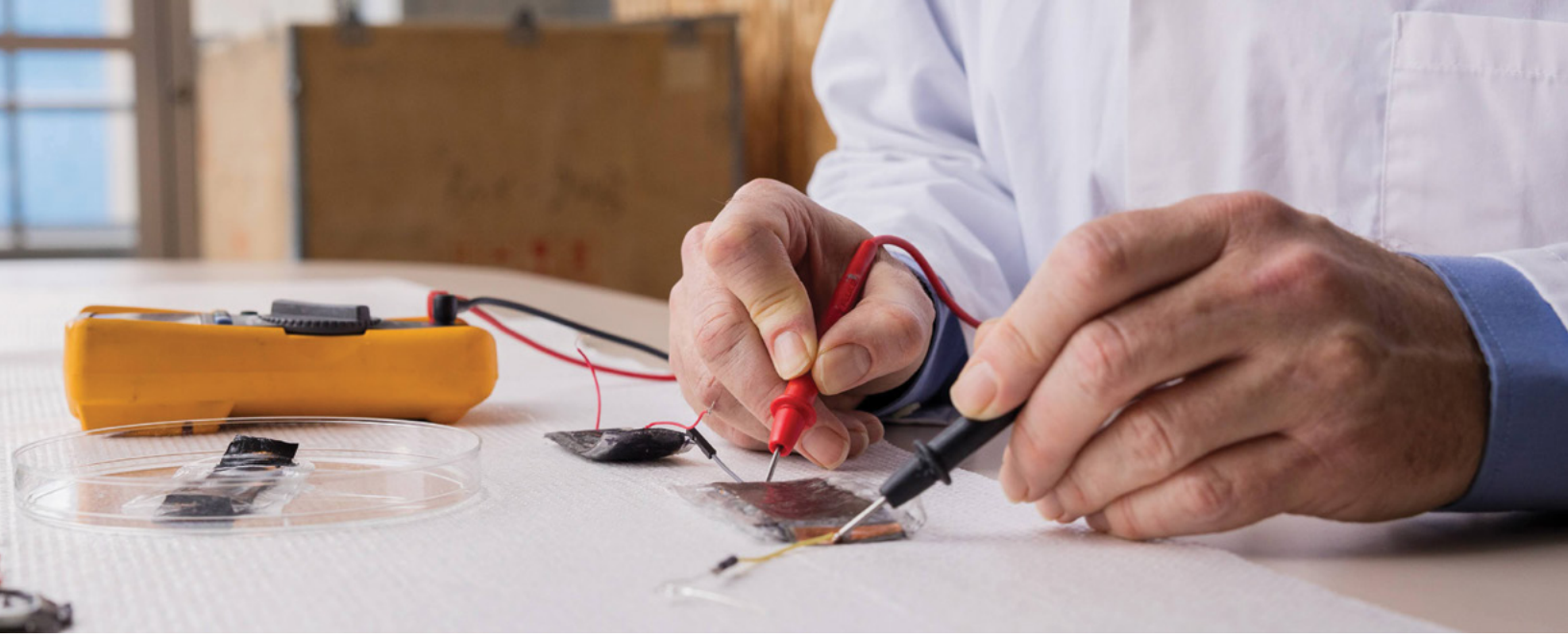
STRATEGIC PARTNERSHIPS

UBCO Success Story
Creating Circular Economies for Wastewater

Metro Vancouver is proactively integrating the research and development of converting wastewater biomass to renewable resources through potentially patentable processes considered "world firsts." This work is being undertaken in a partnership with the University of British Columbia's Bioreactor Technology Group, led by Dr. Cigdem Eskicioglu, NSERC/Metro Vancouver Industrial Research Chair (IRC) in Advanced Resource Recovery from Wastewater.

Dr. Eskicioglu is internationally recognized for her research on new bioreactor technologies for maximizing energy and resource recovery from organic waste, particularly wastewater sludge. Her research group recently took the lead in Canada when it established a research program to investigate the effects of novel sludge pretreatment technologies and advanced sludge digestion on the fate of emerging contaminants of concern (i.e., pharmaceuticals and personal care products, hormones, antimicrobials). The group operates three state-of-the-art laboratory facilities (Advanced Anaerobic Digestion, Particle Sizing/Imaging and Micropollutant Detection) at UBC's Okanagan campus. In the last 11 years, Dr. Eskicioglu's research has generated significant academic, economic and societal benefits for the wastewater industry in British Columbia. The IRC program builds on a long-term and successful collaboration between Dr. Eskicioglu and Metro Vancouver.

The proposed research program aims to generate new technical knowledge, intellectual property, revenue and expertise essential for Metro Vancouver and for Canadian water utilities in general. The technologies under evaluation can help to build treatment facilities that are net-zero energy, better integrated with the community and more sustainable. Furthermore, the program will help develop the next generation of scientists, engineers and decision-makers in these research areas, giving them the opportunity for hands-on, industry-based work, and preparing them to successfully secure jobs in this in-demand industry.



Complex Challenges and Impactful Research: Performance and Benchmarking

The diversity of APSC research represents the **broad range of disciplines** within the Faculty and its ability to address complex challenges while producing impactful research across many domains (Figure 6a and 6b). **Areas of strength showcase the multidisciplinary expertise within our departments and schools**, including social and natural sciences, health research and engineering. Top worldwide research impact in health care (COVID-19, men's health), ICT (computer algorithms and models, quantum) and clean energy (electric transmission and wind power, hydrogen) shows the link between research and APSC's strategic objectives, supporting **Solutions for People**, **Thriving Cities and Communities** and **Planetary Health**.

APSC's **research impact** compared against the UBC average and the U15 (Canada's top 15 universities) shows **a trend of higher relative performance in a number of metrics**. Examples of these include views per publication and field-weighted views impact – indicating that the scientific community is accessing APSC publications more often than those of competitors. Other examples include the output in top 10% citation percentiles and publications in top 10% journal percentiles, highlighting the world-leading quality of APSC research that is cited more frequently and included within leading journal publications at a higher rate than competitors (Figure 7).

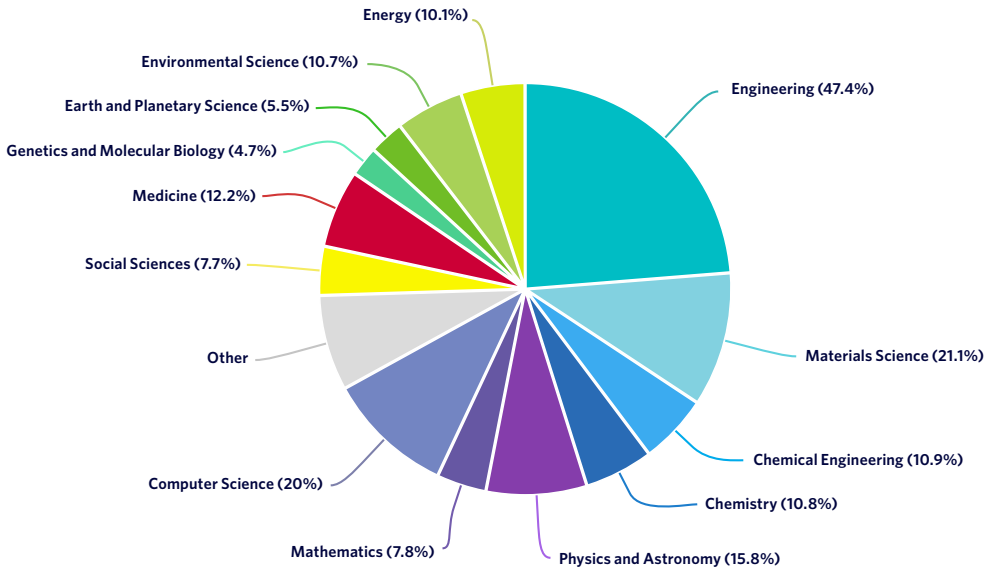


Figure 6a *– APSC publications across subject areas. Segment size represents relative publication share per subject area. Note that a publication can be mapped to multiple subject areas. Source: SciVal.*

APSC has also maintained its **strong research quality and output**, maintaining an average of **~1,500** publications annually since 2017 (**nearly 9,000** cumulatively, of which 19% are in the top 10% of most cited publications worldwide) and a consistent average of **~1.5** in field-weighted citation impact (FWCI) over the same time period, with an FWCI of **1.84 in 2021** (last complete year of data).[3] The Faculty members are also highly collaborative, with over 4,500 publications (49% of total) resulting from **international collaboration** and over 1,600 (18%) resulting from **national collaboration** over 2017-2022. Moreover, a recent study by Stanford University determined that over 100 APSC researchers are among the top 100,000 most cited scientists across all scientific fields, or within the top 2% most cited of their subfields. It is worth noting, however, that these figures do not capture every impact across our entire faculty; see below for detail.

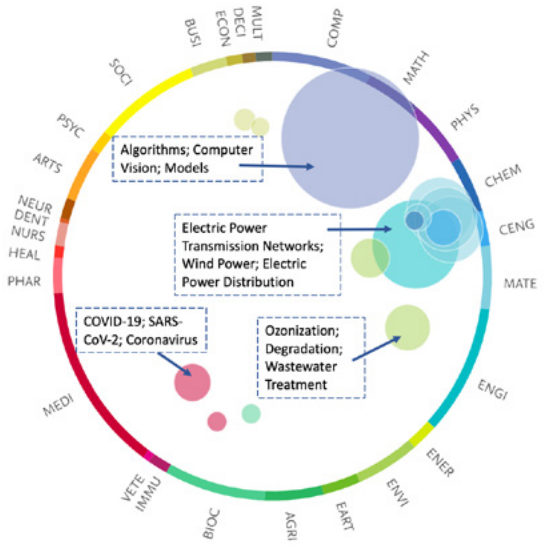


Figure 6b *– The top 1% of worldwide topic clusters APSC researchers have contributed to in the past five years. (SciVal).*

Views per publication	Field-weighted views impact	Output in top 10% citation percentiles	Publications in top 10% journal percentiles
37% above UBC average	**12%** above UBC average	**17%** above UBC average	**12%** above UBC average
59% above U15 average	**34%** above U15 average	**35%** above U15 average	**20%** above U15 average

Figure 7 *- The higher relative performance of APSC researchers versus the UBC and U15 average in various scholarly metrics. Percentages generated with SciVal benchmarking averages over 2017-2022.*

[3]The Research and Partnerships team acknowledges that traditional metrics do not capture the outputs and impacts of our entire Faculty, and are geared much more strongly towards engineering and natural science fields. With the implementation of DORA standards, we are seeing a shift in how research impact is quantified and presented; for example, researchers are now asked not to provide their H-indices in Tri-council grants, nor cite the impact factor of journals they publish in. While this report still relies heavily on bibliometrics supplied by databases such as SciVal, we continue to explore ways in which to present a more holistic, inclusive picture of research impact within our Faculty.

Climate Action and Awareness

Over **$5 million** has been awarded to two APSC teams in the inaugural Climate Action & Awareness Fund, a major initiative launched in 2020 that strongly aligns with APSC's multidisciplinary and innovative research around climate action. The first project, led by Dr. Amanda Giang and Dr. Patrick Kirchen of UBC's Mechanical Engineering department, involving research on urban freight system emissions to improve mitigation planning, achieved an award of **$2.4 million**. The second award (**$2.9 million**) was to Dr. Mahmudur Fatmi of UBC Okanagan's School of Engineering, whose project integrating the development of innovative data, models and a community outreach tool enables the decarbonization of passenger transport.

Both of these projects analyze current transport emissions within BC and will support governments and industries in making greener choices, aiding APSC's strategic goals of improving **Planetary Health** and supporting **Thriving Cities and Communities**.

The Research and Partnerships team provided holistic, comprehensive support for this competition, despite it being new to all involved. The team worked diligently with an agency, researchers, VPRI and other units across UBC to ensure APSC applicants had the information and support they needed to maximize success in this crucial program.

Our Strategies: Strategic Partnerships

APSC is a leader in attracting industrial funding. While the number of industry-funded projects decreased in 2021-2022, the *total funding quantity* has increased for APSC Vancouver, again indicating researchers' ability to secure **larger, higher-value grants** and funding from industry partners. At the School of Engineering, both the number of funded projects and overall funding quantity have steadily increased over the five-year period ending in 2021-2022 (Figure 8). This can also be evidenced from the School of Engineering's considerable success in NSERC Alliance grants, with **three of the top five most lucrative Alliances being secured by School of Engineering researchers**, representing >$5M in funding.

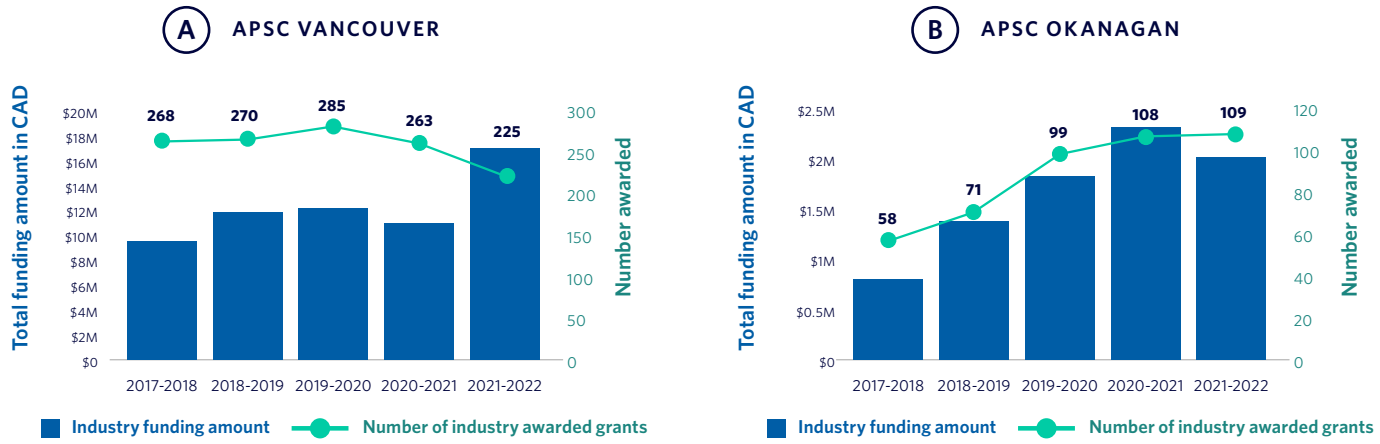


Figure 8 *– Industry funding amount (blue bars) and number of industry-funded projects (green line) for APSC Vancouver (left) and the School of Engineering (Okanagan) (right), 2017-2022. Includes contracts and grants.*

$19.3M INDUSTRY FUNDING

334 TOTAL PROJECTS

APSC's funding partners are from diverse backgrounds, and our researchers have productive and collaborative relationships with major Canadian, US and international companies (Figure 9). In 2021-2022 the highest funding amount from **industrial partners** came from non-US international companies (~$7.1 million), followed by BC, Canadian and US companies. APSC also receives funding from various **not-for-profit** organizations, with the highest cumulative funding amount over the last five years coming from the **British Columbia Hydro and Power Authority**, the **Public Health Agency of Canada** (a significant source of funding for our School of Nursing) and the **Association of Professional Engineers and Geoscientists of British Columbia**. Looking forward, our Research and Partnerships team is working to both diversify our funding partners further and to secure long-term, mutually beneficial partnerships across key research areas.

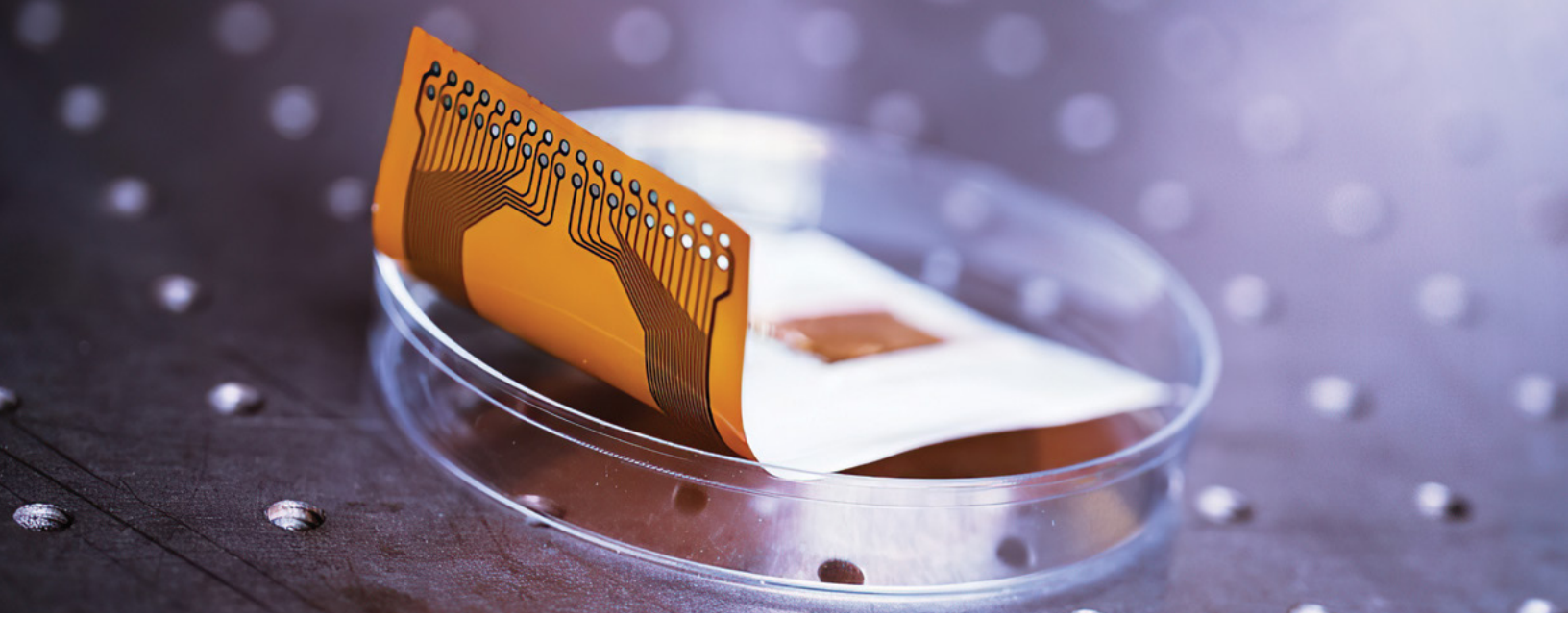
STRATEGIC PARTNERSHIPS

Fraunhofer Partnership

Researchers from APSC, the Fraunhofer Institute for Experimental Software Engineering and the Fraunhofer Institute for Machine Tools and Forming Technology recently announced the **UBC-Fraunhofer Collaboration on Industrial Digital Transformation,** a joint collaboration targeting the technology and processes required to digitize the manufacturing sector. The initial two-year pilot will pool research expertise from the three institutions to create "digital twins" for manufacturers in aerospace, automotive and machine tools, with a further three years focused on expansion into new industry sectors, including mining, digital health, and materials and composites.

According to **Dr. Walter Mérida, APSC's Associate Dean of Research and Industrial Partnerships**: *"This type of collaboration is not just an economic opportunity and a great platform for scientific discovery ... it has become now a necessity, given the short time frame that we have with the challenges that we are experiencing. We don't have 100 years to change our energy systems without accelerating the innovation required to do that."* In addition, **Marc Eichhorn, Consul General of the Federal Republic of Germany**, called the collaboration a *"milestone of scientific collaboration and our commitment for the future."*

The Research and Partnerships team, in particular Dr. Yaser Roshan, Senior Manager, Research Partnerships, built on previous work initiated within UBC and APSC to help bring this historic collaboration to fruition. Through this new agreement, UBC became one of the only Canadian academic institutions with research partnership agreements with the three major research institutions in Germany.



Our Strategies: Innovative Spirit and Entrepreneurial Thinking

Showcasing our **innovative spirit**, APSC research continues to make a scientific and technological impact on industry, with **over 100 patents filed per year since 2017**, and a **steady increase in issued patents** over the same time period – from ~8% conversion in 2017 to 52% in 2021 (Figure 10). The **impact** of APSC's patents is also far reaching, with **higher citations per patent than both UBC and the U15** (comparator group of Canada's top 15 universities).

APSC researchers are very active in **entrepreneurial thinking** and **spinning out** their research into successful, lucrative companies, with **18 enterprises** launched over the past five years (*see the article on antimicrobial copper coatings on the next page for an example).* Finally, as mentioned previously, APSC captures the highest proportion of industry funding at UBC (24% in 2021-2022) and is the leading recipient of NSERC's Alliance grants, the Tri-council's flagship partnered research program. Looking forward, we aim to increase our share of industrial funding even further by following our strategy of securing long-term, mutually beneficial and lucrative partnerships.

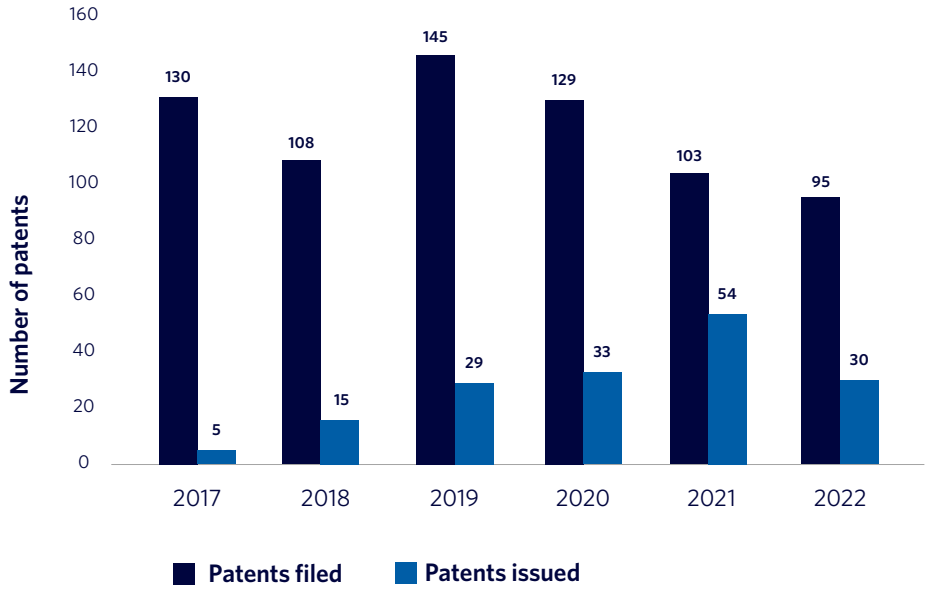


***Figure 10** – Patents filed for and patents issued, APSC overall (2017-2022). Source: UBC UILO. Note that 2022 data does not reflect the complete year.*

INNOVATIVE SPIRIT AND ENTREPRENEURIAL THINKING

Antimicrobial Copper Coatings

When installed on high-touch surfaces, copper will eliminate up to 99.9% of harmful bacteria within two hours of contact. A collaboration between APSC researchers and **Teck Resources**, one of Canada's largest mining companies, has led to the installation of more than 400 antimicrobial copper patches on door handles and railings in buildings around the UBC campus. This builds on Teck-funded research led by **Dr. Amanda Clifford** and **Dr. Ed Asselin**, CRC T2 from the Department of Materials Engineering, who are developing an advanced copper coating that will kill certain types of bacteria quicker than unmodified copper. The coating is designed to help reduce the spread of aggressive infections contracted through contaminated surfaces.

One of the primary aims of Teck's Copper & Health program is to improve health outcomes for people and communities, aligning directly with APSC's own commitment to work closely with partners in order to develop and implement **Solutions for People** that support healthy, safe and sustainable communities. Remarking on this project, **Teck President and CEO Don Lindsay** states: *"We are proud to partner with UBC Applied Science on this installation of antimicrobial copper in high-traffic spaces, which creates a safer environment for students and staff."*

INNOVATIVE SPIRIT AND ENTREPRENEURIAL THINKING

APSC spinoffs

APSC researchers have long been at the forefront of technology transfer, developing their research into impactful, lucrative spinoffs readily taken up by industry and society. While a full list is available from **UBC's UILO office**, **recent and notable successes** include:

Dream Photonics

Dr. Lukas Chrostowski, Dr. Sudip Shekhar, ECE

Founded in 2020 and combining decades of academic and industry experience in silicon photonics and CMOS electronics, Dream Photonics is actively engaged in process design kit development for silicon photonics foundries across the globe.

Bioform Technologies

Dr. Mark Martinez, CHBE

Founded in 2021 and already receiving significant funding and investor interest, Bioform uses the world's most regenerative materials (kelp, wood pulp) to create products that sustainably eliminate plastic waste.

Mangrove Lithium

Dr. David Wilkinson, CHBE

Mangrove's mission is to leverage its breakthrough lithium refining technology to unlock a battery-powered, clean energy future by bringing more lithium and electric vehicles to the market. Mangrove has achieved more than US$25 million in funding since launching in 2013, and is developing a commercial-scale plant.

APSC Research Support Landscape

This report was prepared by Joanne Moszynski and Tristan Heap from the APSC Dean's Office Research and Industry Partnerships team with support from the entire Research and Partnerships team, the Office of Research Services, the Office of the CIO, the APSC Marketing & Communications team and APSC Faculty Affairs. The team would especially like to acknowledge Tristan Heap, Work Learn Research and Communications Assistant, who was primarily involved in preparing the report, and Devan Power, Creative Manager for the design and layout.

Growth in research funding and partnerships continues to be the strategic priority for our Faculty. In support of this, the development and expansion of the Research and Industry Partnerships (R+P) team within the Dean's Office has been a substantial and strategic investment by the Faculty. Over the period 2020–2022, this included creating two Senior Manager, Research Partnerships positions within the Partnerships team, and hiring two research development associates to join the existing Senior Manager, Research Development in the Research Development team. Overseen by the Associate Dean, Research and Industrial Partnerships and the Dean, the two parts of the R+P team provide co-ordinated and complementary support to increase research funding success, real-world impact and commercialization activities.

The Research & Industry Partnerships team's reputation for excellence in research drives access to funding and maximizes the multiplying factor of grants and other sources to benefit our partnerships. We actively seek collaboration with industry, non-profit and municipal, provincial and federal government partners to accelerate solutions for the future.

Contact us: **research@apsc.ubc.ca**

Walter Mérida
Associate Dean,
Research and Partnerships

Joanne Moszynski
Senior Manager,
Research Development

Kyra Laverdiere
Senior Manager,
Partnerships

Yaser Roshan
Senior Manager,
Partnerships

Meisan Brown-Lum
Research Development
Associate

Atif Hussain
Research Development
Associate

Tristan Heap
Research and Communications
Assistant

What we do

As discussed in the highlighted stories within this report, the R+P team have been closely involved in supporting APSC researchers at all levels, from foundational needs such as securing their NSERC Discovery Grants and CFI JELFs, to developing large, interdisciplinary team projects and identifying and engaging with partners across all sectors. In addition to supporting grants and partnerships, we work collaboratively on Faculty-wide strategic projects, which will be built upon and expanded in 2023. In the future, we aim to continue providing professional, expert support to our Faculty members and excelling at our core programs and services while strategically expanding our scope into new domains, including increased support of international grants, increased engagement across faculties in support of truly transdisciplinary and interdisciplinary research and an enhanced focus on big opportunities to strengthen our areas of research expertise.

We also want to acknowledge the extensive expertise embedded within our Faculty at its departments, centres and schools. The R+P team is fortunate to work within a productive and collegial support network consisting of program managers, grants facilitators, business development staff and many others, all with the mandate of supporting APSC researchers' capacities towards truly impactful, world-leading research.

QUOTES ABOUT THE TEAM

"I so appreciate all of the support that you provided to me during the process. Your eye for detail is quite amazing and you definitely pushed me to strengthen my application. Thank you."
– CRC AWARDEE

"Thank you all very, very much for your detailed critique, suggestions, probing questions and encouragement! In the end we were very well prepared for the jury."
– TEAM LEAD, LARGE PROJECT AWARDEE

"Without the R+P team, APSC would not have this CERC."
– SENIOR ADMINISTRATOR, APSC

New and Ongoing Capacity-Building Programs

DISCOVERY GRANT & ALLIANCE GRANT BOOTCAMPS:

Over the last five years, the Research and Industrial Partnerships team has delivered annual bootcamps to provide guidance to researchers submitting Discovery and Alliance grant applications. These sessions have had a positive impact in boosting the success rate of APSC applicants compared to their national counterparts. APSC applicants now have a 68% success rate compared to the national average of 57% for the Discovery grants and a 73% success rate compared to 54% for the national average for Alliance grants.

The Discovery Bootcamp includes:

- An introduction to the Discovery Grant process and criteria
- The development of personal impact documents
- Group exercises to peer-review sample grant applications and impact documents
- A panel discussion with successful grant recipients

The Alliance Bootcamp is designed to help researchers gain insights on different Alliance funding streams and their criteria. The bootcamp offers researchers tips and guidance on proposal writing, as well as opportunities to connect with session panelists sharing expertise and learnings from their successful applications.

RESEARCH LEADERSHIP PROGRAM:

In the summer of 2021, the Research and Partnerships team developed and launched a pilot of the Research Leadership Program to provide researchers with knowledge, tools and skillsets to build capacity across grant writing, partnership management, knowledge exchange and leadership. The pilot program was open to faculty members across all career stages and consisted of group workshops, webinars and interactive panel discussions. Topics included: establishing one's self as a research leader; devising a five-year funding plan; partnering with cities, communities and non-profit organizations; and developing a value proposition for collaboration.

Building on feedback from the pilot, the Research and Partnerships team rolled out a revised version of the program in the spring of 2022 that used a cohort format and featured experienced speakers and facilitators from across APSC, UBC and beyond.

Evaluating the external environment	**Developing a five-year funding plan**
Creating a pitch and aligning goals, objectives and outcomes	**Effectively managing research finances**
Managing intellectual property at UBC	**Translating knowledge for impact**
Personal branding workshop: How to best leverage social media to present a personal brand	

We will incorporate feedback into the next iteration of the Research Leadership Program, which we will deliver in the coming year.

CLUSTER ADVANCEMENT PROGRAM

Networked, interdisciplinary research clusters bring together experts from various disciplines to work on solutions to complex problems. UBC established the Grants for Catalyzing Research Clusters (GCRC) program in 2017, followed by UBC Okanagan's Eminence Program, both of which enable the formation and growth of interdisciplinary research excellence clusters.

APSC is introducing a comprehensive approach to supporting our APSC-led GCRC and Eminence clusters. The Research and Partnerships team will work with cluster leads to develop a tailored support model with supplemental funding available to cover:

- Establishing a robust resourcing model to enable cluster objectives
- Developing communication collateral and strategies to build awareness
- Facilitating professional workshops with external stakeholders

Use of this supplemental funding will be assessed over the coming years to gauge the return on investment and impact from this program.

PRESIDENT'S ACADEMIC EXCELLENCE INITIATIVE

The President's Academic Excellence Initiative program was launched in 2021 to fund the hiring of nine research professors across the Faculty, with one in each Department or School at UBC Vancouver. These nine new hires will support the strategy of "integrated disciplines" and will establish a Thriving Cities & Communities research and education hub at UBC. This purpose-built research and education cluster will build on the strengths and strategic priorities of the Faculty and provide unique opportunities to integrate diverse approaches to advancing technology, policy and design inherent in each discipline.

The Research and Partnerships team is advising on the implementation of the Thriving Cities and Communities Hub – a platform to support the integration of new and existing hires with shared impact goals. The team is working with new hires to provide support for research and partnership development.

CO-CREATION AND ENGAGEMENT MECHANICS

APSC has had repeated success engaging strategic partners to develop industrial co-led research consortiums and bringing together players across value chains to share the risk and reward involved in tackling complex challenges that require novel solutions.

The process can be tailored as needed, but generally includes:

1. Identifying a research leader and strategic innovation theme
2. Inviting industry, government, and civil society to define their shared challenge(s)
3. Engaging APSC researchers in a workshop to brainstorm potential approaches to address these challenges
4. Facilitating a joint session to present approaches, discuss models for collaboration and prioritize project needs
5. Leveraging workshop outcomes to form the mission and scope of a new consortium agreement
6. Publishing a report to build awareness and support for these efforts with peripheral stakeholders and funders

The Natural Gas Futures consortium, the Transportation Futures consortium and the Coastal Adaptation Lab were all born out of this process.

Contact

If you have any questions regarding this report
or obtaining further information, please contact:

Phone +1 604 822 6413
Email **research@apsc.ubc.ca**