UNIVERSITY OF HAWAIʻI SYSTEM REPORT

REPORT TO THE 2021 LEGISLATURE

Report by Hawaiʻi EPSCoR on Hawaiʻi State Science and Technology Plans

Act 137, Session Laws of Hawaiʻi 2009

December 2020

TABLE OF CONTENTS

A Report by Hawai‘i EPSCoR on Hawai‘i State Science and Technology Plans

As required in Section 4 of Act 137, Session Laws of Hawai‘i 2009, Hawai‘i EPSCoR is submitting a report on the status of the State of Hawai‘i’s Science and Technology Plan. The original Plan was submitted to Governor Linda Lingle and the leadership of both houses of the legislature on January 27, 2010.

1. Background and Context

1.1. Act 137 History.

In 2008, the state was working on multiple fronts to promote and incentivize the science and technology sectors of the Hawai‘i economy. Adjustments were being made to the Act 221 high technology tax credit, the Hawai‘i Science & Technology Council (HSTC) was building a network of technology companies in the state and the University of Hawai‘i was preparing a 5-year, $20M proposal to the National Science Foundation’s Established Program to Stimulate Competitive Research (EPSCoR) program’s Research Infrastructure and Improvement (RII) solicitation.

The EPSCoR program’s importance lies in its direct connection to the strong research capacity of the University of Hawai‘i as a driving force for supporting a growing science and technology (S&T) industry through pursuit of basic knowledge, technology transfer, commercialization of discoveries, and education of a STEM workforce. This increased R&D capability was expected to provide key research infrastructure and further stimulate Hawai‘i’s economic development, including a diverse, well-prepared, STEM-enabled workforce. Moreover, EPSCoR designation by the National Science Foundation (NSF) allows Hawai‘i researchers to participate in EPSCoR-like programs in other federal agencies including the National Institutes of Health (NIH) Institutional Development Award (IDeA) program and the U.S. Department of Energy and NASA EPSCoR programs.

Following the completion of its landmark 2008 report *Innovation and Technology in Hawai‘i: An Economic and Workforce Profile*, the HSTC and its network of members and stakeholders began working with the legislature to formally support S&T industries as economic drivers of the state. HB610 was introduced into the 25th Legislature with the intent of incorporating references to science and technology throughout HRS Section 226-6, Objectives and policies for the economy-in general, based on the economic impact of the existing technology sectors on the state economy.

In addition to formally recognizing S&T as important sectors of our economy, the addition of Hawai‘i S&T industries in HRS Chapter 226 also fulfilled a requirement by the National Science Foundation (NSF) that the research proposed for their Research Infrastructure and Improvement Track-1 (RII) competition align with state S&T priorities. To document this alignment, NSF requires each submitted proposal package to include evidence of a state S&T plan and endorsement of the proposal by the state’s EPSCoR Steering Committee.

The subsequent HB601 Relating to Science and Technology was passed by the 25th Legislature despite overwhelming testimony in opposition to the bill by stakeholder groups including Department of Business, Economic Development & Tourism (DBEDT), Hawai‘i EPSCoR, the

High Technology Development Corporation (HTDC), the University of Hawai'i (UH) System, the Hawai'i Science & Technology Council, the Hawai'i Venture Capital Association and several private S&T companies. The final bill required Hawai'i EPSCoR, with the assistance of HTDC to develop a Hawai'i State S&T Plan. Governor Linda Lingle signed it into law as Act 137 on June 19, 2009.

The initial deliverable of Act 137 was to provide a plan to the legislature no later than 20 days prior to the 2011 regular session that included:

1. An evaluation of the effectiveness of past and current science and high technology legislation, including legislation relating to industry development, incentives, oversight, and sustainability;
2. A plan for the direction of Hawai'i's science and high technology sector, including:
    a. A list of goals established for the science and high technology sector in the state;
    b. A plan to reach the established goals; and
    c. A timeline for implementation and completion
3. Criteria to measure the growth of emerging growth industries in the science and high technology sector;
4. Guidelines for future science and high technology legislation to assist the legislature in maintaining an overall framework to guide the development of science and high technology in the state; and
5. Recommendations or proposals for science and high technology legislation to meet the goals established in the plan.

1.2. State Science and Technology Plans and NSF EPSCoR Funding Cycles.

The state's technology community was largely organized under the leadership of the Hawai'i Science & Technology Council and included board representation of both Hawai'i EPSCoR and HTDC. A decision was made to leverage the Council's knowledge assets to support the production of a first S&T Plan as called for in Act 137. A meeting of stakeholders in the early summer of 2009 produced a timeline for the development of the S&T Plan.

On January 27, 2010 the first framework plan, "Hawai'i State Science & Technology Strategic Plan Framework," was delivered to Governor Linda Lingle, Senate President Colleen Hanabusa, and House Speaker Calvin Say. Sections of the framework document provided a vision for Hawai'i S&T in 2020, and a framework of statewide S&T strategic priorities, near-term goals, and enabling strategies that would help guide the State's utilization of resources to achieve a vision of a vibrant S&T enterprise -- including a diverse, well-prepared, STEM-enabled workforce. The Plan also included a summary of outreach efforts that were conducted with companies and organizations across the state.

Since that 2010 report, the Hawai'i EPSCoR RII Track-1 NSF program has been successfully renewed for two 5-year cycles, totaling a $40M research and education investment, for the period

2009 – 2014 and 2016 - 2021. Each of these 5-year cycles was accompanied by a new iteration of the Statewide Plan (editions 2012 and 2016). Each edition of the Statewide Plan (SWP) was, in turn, accompanied by a newly convened Statewide Committee. The composition of this Committee varied but always included academic leadership and researchers, educators, the legislature, state and ffederal agencies, and the non-profit and business community. As we entered 2020, the Hawai'i State EPSCoR program geared up for the submission of a proposal to NSF for a $20M, 5-year renewal of the RII Track-1 program and, in parallel, developed a new iteration of the SWP. This proposal and draft SWP were submitted on July 31, 2020 and the outcome of the NSF peer-reviewed process will be known in late 2020.

Table I. Editions and Titles of Hawai'i Statewide Science and Technology Plans

Hawai'i State Science and Technology Plans 2012 - 2025	
2012 - 2016	Sustaining and Improving Quality of Life for a Prosperous Hawai'i.
2016 - 2020	Building a 21st Century Economy for Hawai'i.
2020 - 2025	Harnessing the data revolution in support of Hawai'i's future.

Table II. Cycles of the RII Track-1 EPSCoR Programs for Hawai'i

Cycles of RII Track 1 EPSCoR Programs in Hawai'i	
2003 - 2006	**Investing in Multidisciplinary University Activities through Hawaii EPSCoR**
	OIA 0237065 $8,995,525 PI J Gaines, Co-I E Laws, K Kaneshiro, D Price
	University of Hawai'i System, UH Manoa, UH Hilo, Chaminade University
2006 - 2011	**IMUA 2 NSF Hawai'i EPSCoR**
	OIA 0554657. $9,249,974. PI J Gaines, Co-I K Kaneshiro, D Price
	Unversity of Hawai'i System, UH Manoa, UH Hilo, Chaminade University
2009 - 2014	**IMUA III: Pacific High Island Evolutionary Biogeography: Impacts of Invasive Species, Anthropogenic Activity and Climate Change on Hawaiian Focal Species**
	OIA 0903833. $20,000,000 PI: D Straney
	University of Hawai'i Manoa, UH Hilo, Chaminade University
2016 - 2021	**'Ike Wai: Securing Hawaii's Water Future**
	OIA 1557349, $20,000,000 PI G Jacobs, Co-I H Turner, B Bruno, P Mouginis-Mark, M Platz
	University of Hawai'i System, UH Manoa, UH Hilo, Chaminade University

2021 - 2026	**MIDAAS: Microbiomics Integrated with Data Analytics to Advance Sustainability**
	submitted - under review. $20,000,000. PI G Jacobs, Co-I J Leigh, H Turner, P Johnson, N Hynson
	University of Hawai'i System, UH Manoa, UH Hilo, Chaminade University

2. EPSCoR RII Track-1 Cycles in Hawai'i: Outcomes and Impacts

Specific highlights of the prior EPSCoR cycles in Hawai'i are outlined below:

2.1. IMUA III: Pacific High Island Evolutionary Biogeography: Impacts of Invasive Species.

This project increased the competitiveness of Hawai'i investigators in critical areas of ecological science and island biogeography, broadened participation in the state's STEM workforce through enhanced K-12, undergraduate and graduate student pathways, and worked to fundamentally improve relationships between researchers and local communities.

In coral reef studies (Gates) 13 IMUA III papers described linkages between genomics, transcriptomics and metabolomics. The nature and composition of coral symbiomes over space and time was defined, and IMUA III established the 3D structure from motion stereogrammetry, established as a transformative topological mapping and mathematical modeling technique for the benthos. IMUA III established the Climate-Ecosystem Observatory, a network of eight climate stations and three marine sensor buoys with state-of-the art equipment on both the windward and leeward sides of Hawai'i Island. A novel high-resolution, long-term, submarine groundwater discharge-monitoring instrument was also developed and deployed. Two demonstration projects at Chaminade and UH located at the interface between science/indigenous knowledge and Hawaiian culture were successful, specifically on the culturally informed metabolomics of the Hawaiian ritual drink kava and the traditional ecological knowledge/ecological genomics of Hawaiian limu, a traditional marine food source.

Institutional capacity built during or in parallel with IMUA III included hires in sensor engineering (David Garmire, twice-winner of the Berkeley Nanotechnology Opportunity award and the University of California, Berkeley Venture Labs Achievement award) and ddata vvisualization/aanalytics (Jason Leigh, Director Emeritus University of Illinois at Chicago Electronic Visualization Lab). Cyberinfrastructure gains in IMUA III included a geographic information system (GIS) lab at UH Hilo, and a new High Performance Computing Cluster, data storage and data science team housed within a new (2014) $40M UH Information Technology Center. IMUA III enabled Hawai'i researchers to secure almost $78M in additional extramural funding, including 20 non-EPSCoR awards from NSF. IMUA III catalyzed a Paul Allen Prize (Ruth Gates), NSF EarthCube Research Coordination Network award, Chaminade University's first prime awardee NSF grant (Improving Undergraduate STEM Education, Helen Turner), a science/culture grant from Office of Hawaiian Affairs (Helen Turner), NSF Advanced Cyberinfrascture (ACI) award (Campus Cyberinfrastructure, Gwen Jacobs), and an NSF math education grant to UH Hilo. In addition, project faculty, staff and students published a total of 249 peer-reviewed journal articles, 16 papers in conference proceedings, 8 book chapters, 4 PhD dissertations, 11 MS theses, and delivered 356 presentations and posters at state, national and international scientific conferences.

2.2. 'Ike Wai: Securing Hawai'i's Water Future (2016-21).

'Ike Wai is a transdisciplinary study of two aquifer systems that is building capacity for hydrogeological research in Hawai'i, creating workforce pathways for research and industry, and producing actionable information for water managers and policy makers in Hawai'i. Key research findings include data to support a lack of aquifer boundaries in highly porous basalts and a map of five distinct groundwater flow paths from the mountains to the coast based on

oxygen isotope measurements in submarine groundwater discharge and geochemical analyses of over 400 well and pond samples. The results of a novel microbiome community analysis indicated that the temporal and spatial distribution of groundwater microbial communities can provide information regarding aquifer connectivity, and show alignment with the geochemical results. A novel marine geophysics study along the Kona coast suggests that there may be twice as much freshwater stored offshore of Hawai'i Island than was previously thought, with important implications for islands around the world. An extensive reservoir of freshwater within the submarine southern flank of the Hualālai aquifer has been mapped by 'Ike Wai researchers. The groundbreaking findings reveal a novel way in which substantial volumes of freshwater are transported from onshore to offshore submarine aquifers along the coast of Hawai'i Island. This mechanism may provide alternative renewable resources of freshwater to volcanic islands worldwide.

A new Science Gateway online platform is a data analysis source for the state and region, serving as the central location for data management, computation, analysis, visualization, and dissemination of all data and data products generated by the 'Ike Wai project. These include stakeholder-driven rainfall recharge scenarios representing the futures of urban, agricultural, and conservation lands and well pumping optimization models of interest to local water boards. 'Ike Wai also made a significant investment in exploring historical and contemporary Hawaiian knowledge relating to water and hydrology. In particular, an 'ōlelo Hawai'i newspaper translation and data analytics effort saw Hawaiian language experts and scientists working together to identify water-related information present in the rich archive of Hawaiian newspapers from the 19th and early 20th centuries.

The 'Ike Wai project ends in May 2021. Productivity by the team to date is very high. Participants have published 137 peer-reviewed publications and 'Ike Wai participants have submitted 122 proposals resulting in awards totaling $30,268,420 including 9 NSF awards to date. Overall, 135 individuals have participated in 'Ike Wai including 33 faculty, five postdoctoral fellows, 24 graduate students, six non-technical support staff, 13 technical support staff, 54 undergraduate researchers and various stakeholders from the community. Student trainees have completed 14 PhD or MS degrees. 'Ike Wai funded the hire of five new faculty at UH Mānoa to build capacity in water resource research in the fields of geology, engineering, economics and geophysics. At UH Hilo four new 'Ike Wai-funded faculty hires have implemented a Data Science Certificate program that is now planned to become a baccalaureate degree. At Chaminade, a new Data Science program with an undergraduate degree and certification tracks has been implemented and new faculty hires have been made in Data Analytics, Environmental Science and Biology. As a Native Hawaiian-serving institution, Chaminade has also supported 152 Native Hawaiian STEM undergraduate sscholars (97% retention, 100% graduation rate) through a series of awards (Kamehameha Schools, NSF, NIH) that are leveraged from 'Ike Wai. Cyberinfrastructure resources and research have increased significantly with five new 5-year NSF awards in 2019 and 2020 in software frameworks, high performance computing, international networking, advanced data visualization and distributed cloud computing for a total of over $10M in assets. These new cyberinfrastructure resources position the UH research community to be on par with their colleagues on the mainland and are essential to the support of the UH research mission.

3. New Horizons: the 2021-26 RII Track-1 EPSCoR and Accompanying Statewide Plan

3.1. MIDAAS and the 2020 Statewide Plan Revision.

In 2020 a transdisciplinary team of leadership, researchers and educators from the UH System, UH Mānoa, UH Hilo and Chaminade University developed a vision for the next 2021-26 5-year cycle of EPSCoR in Hawai'i. The University of Hawai'i and its primarily undergraduate-serving institution (PUI) education partners proposed the EPSCoR RII Track-1 Microbiomics Integrated with Data Analytics to Advance Sustainability (MIDAAS) project to NSF in August 2020. MIDAAS integrates microbiology and data science to support research competitiveness, workforce development and the infrastructure needed as we diversify Hawai'i's economy and secure sustainable growth and ecosystem resilience. MIDAAS offers the potential for novel microbiome-based restoration and management solutions across four ecological and agricultural contexts of central importance to the state, and develops the necessary innovations in data sciences to deliver these solutions. The program leverages UH investment in two multidisciplinary institutes in the Center for Microbiome Analysis through Island Knowledge and Investigation (C-MĀIKI) and the Hawai'i Data Science Institute (HI-DSI), as well as Chaminade University's NSF-funded Data Science Center and Community-Engaged Computing program. These institutes offer a new type of structure for innovation and collaboration at UH and across Hawai'i, and MIDAAS will bring them together as an exemplar project that abrogates barriers between domain and data sciences. Integrated with the research activities in microbiology and data science, the MIDAAS project promises robust efforts in technology transfer and innovation. Led jointly by the UH Interim Director of the Office of Innovation and Commercialization - UH Ventures and faculty with an entrepreneurial track-record, the 'Emerging Areas' core of MIDAAS will foster the development and commercialization of data science activity at UH and Chaminade.

The impact of MIDAAS will be to *arrive* at and *provide* to stakeholders (using a major new environmental microbiome bio-banking effort) prescription microbiomes tailored to terrestrial and marine ecosystems and agricultural needs that are deployable across Hawai'i. An integrated education and workforce development effort will span microbiology and data sciences, and focus on early career faculty, data science skills development pathways, a transdisciplinary graduate fellowship program and summer and semester undergraduate research internships. Employer-facing internships and a curated portfolio development platform that is career-facing will support workforce development efforts in Hawai'i, in both career areas linked to microbiome science (agriculture, public health, natural resource management) and data analytics (all sectors) as we seek to move towards the data-rich, data-driven and data-empowered diversified economy and just society envisaged in our statewide Science and Technology plan.

Accompanying and guiding the development of the MIDAAS proposal was the revision of the Statewide Science and Technology plan. The 2021-26 Plan is entitled *'Harnessing the data revolution in support of Hawai'i's future'*. The plan responds to one of the NSF's '10 big ideas' which mapped the future of the STEM endeavor for the Nation. 'Harnessing the Data Revolution' recognizes the centrality of data analytics to the prosperity, health, defense and sustainability of the United

States. It is a call to action for states and NSF-funded programs, and the wider US STEM community, to train a generation of workers who can be deployed in all sectors of the economy and society to harness the power of data to support decision-making and build prosperity. The 2021-26 Hawai'i Statewide Plan responds to this call, highlights the myriad ways in which agency over data and data-driven decision support are critical to the State's future, and offers a mandate to develop research, education and training capacity in this critical area over the next five years.

Hawai'i has recognized that within data science (DS) and analytics lies tremendous potential for increased job creation (for both local and remote workers based in Hawai'i), economic competitiveness and diversification, addressing social inequities, increased research competitiveness and improved decision support and data-driven resource allocation. Hawai'i employers across economic sectors are beginning to hire, under various job titles, analysts, data specialists, business analysts, data engineers, business intelligence professionals, statisticians, data logistics specialists, operations analysts, marketing analysts and communications professionals, all of whom participate in some activities that can be termed 'Data Science'. The lack of a specific Bureau of Labor Statistics job code identifier for data science hampers tracking of these opportunities but there is clear growth and expressed need for data analysts across business and non-profit sectors. There is a growing sense of urgency that Hawai'i prepare to 'surf the data wave' to avoid the potential of a digital divide that leaves the state lagging both in data jobs and the use of data to empower the state. This urgency is illustrated by initiatives such as the Association of Hawaiian Civic Clubs 2019 Resolution, developed by Chaminade University's Data Science Center, to support and advocate for data science that addresses Hawaiian advancement and enfranchises the Native Hawaiian community into the data endeavor. The new Statewide Plan outlines the centrality of capacity in data analytics to research competitiveness across all disciplines, from biomedicine to agriculture, to astrology and marine science. The proposed MIDAAS project for the new EPSCoR cycle offers the first grand exemplar project of advancing a critical domain science (microbiology) through wedding it to advanced data analytics capability.

3.2. Stakeholder Engagement: Planned Composition of the Hawai'i Statewide Science and Technology Committee.

The current EPSCoR principal investigator, Dr. Gwen Jacobs, rebooted and reconvened a new EPSCoR Hawai'i Statewide Science and Technology Committee in 2014 with a mission to "act as an independent organization on behalf of the broader research, business and government interests of the State of Hawai'i." The Committee promotes innovation, collaboration, and excellence towards the goals of a world-class research and development enterprise in Hawai'i that is an engine for economic diversification, prosperity and social justice. For the new EPSCoR and SWP cycles (2021-26), the committee's planned roster has been updated with an emphasis on leadership, diversity of perspectives and commitment to active engagement in support of Hawai'i's future growth and resilience. The committee will review and refine the SWP and commence a regular meeting schedule once the outcome of the 2021-26 RII Track-1 cycle proposal is known (late 2020).

4. Update on Hawai‘i Innovation Initiatives

The University of Hawai‘i System is one of the largest enterprises in the state and is comprised of three universities and seven community colleges across the islands. Because of Hawai‘i’s tremendous geographic diversity that encompasses erupting volcanoes, frozen summits, tropical rain forests and the deep ocean, UH research is equally as diverse with its world-renowned research programs in astronomy, medicine, data visualization, oceanography, genetics, biosciences and tropical agriculture. As Hawai‘i’s only public university and one of only a few Land, Sea, Sun and Space Grant universities in the nation, UH has a dual mission to forge ahead with new discoveries and to energize economic development. Research conducted across the 10-campus UH System and at Chaminade, the innovative solutions derived from it and the ability to rapidly translate a good idea into purposeful products and services are key factors that will help drive economic prosperity and support the quality of life here in Hawai‘i and around the world.

The Hawai‘i Innovation Initiative (HI2) was officially launched at a two-day symposium at the Sheraton Waikiki on January 12-13, 2011. In her conference presentation, President Greenwood noted that UH was seeking to become a major driver of innovation and commercialization in the state by initiating an institution-wide effort to enhance awareness of the potential applications of research and encourage entrepreneurship in its curriculum design, course content, and faculty incentives. President Greenwood listed three objectives in defining UH’s mission. The first objective was to increase the number of educated citizens through the Hawai‘i Graduation Initiative. The second was to “create a 21st-century capability for innovation and technology transfer” supported by “a billion-dollar research industry for Hawai‘i.” The final objective was to renovate and rebuild the university’s infrastructure and to stimulate the creation of small businesses based on technology transfer and University-led innovation.

The findings of the Innovation Council and the outcomes of the January 2011 HI2 Symposium were published by the National Academies of Science in early 2012. Those findings provided a detailed roadmap for UH leadership in the development of an innovation economy in Hawai‘i that integrated the UH research enterprise with government and the S&T industry across the state. Now framed under an innovation ecosystem, issues such as education, investment capital, technology transfer and entrepreneurship training were poised to provide a broader landscape for a state S&T Plan.

In the summer of 2011, the HSTC closed its doors and the S&T Plan committee lost its primary conduit to the state’s technology industries. With the release of the National Academies of Science report, emphasis of coordination of the technology landscape in the state was shifting to a new set of stakeholders around an innovation economy. In the intervening nine years to date, the University's Office of the Vice President for Research and Innovation has continuously led and refined a suite of Innovation initiatives that support the original goals of the HI2 and adapt to changing landscapes. The long-term benefit of the HI2 investment has been the creation of an ‘Innovation Ecosystem’ across UH and private universities in Hawai‘i whereby world-class faculty, highly trained students, and dedicated staff inculcate a culture of entrepreneurship; one where new discoveries are translated into products to benefit the public and people are nurtured

to become business leaders. Today, the University of Hawai'i System has a suite of programs and resources across the 10 campuses to encourage student innovation and entrepreneurship and support students who desire to take their ideas and discoveries to the next level and there is robust innovation ecosystem in the state including incubators, product accelerators, and innovation spaces.

UH Mānoa opened the iLAB, which serves as an innovation center on the UH Mānoa campus. The iLAB provides program facilities, resources and support to act as a catalyst to drive other interdisciplinary innovation initiatives within the UH System. Currently the UH Esports team uses the lab for training and evernts. The Pacific Asian Center for Entrepreneurship (PACE) at the UH Mānoa Shidler College of Business offers over 20 programs to UH students and faculty designed to encourage entrepreneurial thinking across disciplines and inspire entrepreneurs to move their ideas from conception to commercialization. PACE programs include the Breakthrough Innovation Challenge, UH Venture Competition, Summer Startup LaunchPad, Liftoff Advisors and the UH Ventures Accelerator. The Mānoa Innovation Center is a facility to assist and incubate companies that are commercializing intellectual property generated by or affiliated with University research, providing leases at market and subsidized rates. It also houses the University's STEM Pre-Academy program and the Applied Research Laboratory. UH Ventures LLC provides startups with access to early stage funding, including follow-on funding.

In addition, a number of the other campuses across the University of Hawai'i System also have innovation centers, including the Maui Food Innovation Center and the Kauai Innovation Center. The seven University of Hawai'i Community Colleges are part of the Pacific Center for Advanced Technology Training (PCATT), a not-for-profit consortium that offers programs in the STEM areas at its innovative training center. In addition, Chaminade University has established a social incubator in 2020, a new Education Incubator, the Elemental Accelerator, and founded several Native Hawaiian-focused incubators (e.g. WaiWai collective, Purple Maia, Mana-UP).

The UH Office of Innovation and Commercialization (OIC) is uniquely positioned at the center of the University's and the State's ecosystem. In 2020, the OIC pivoted to implement a novel approach to finding solutions to Hawai'i's challenges, exacerbated by the COVID-19 pandemic. The OIC proposes to start by looking at and understanding the challenges Hawai'i faces, identifying challenges to solve, and bringing innovation to solve those challenges to ensure the end result falls in line with the original need. These real-life solutions to Hawai'i's challenges can then benefit from the existing resources in the innovation and entrepreneurship ecosystem to accelerate their development and bring them to market. The OIC also recently launched the 2020 'Hacking for Recovery' entrepreneurship bootcamp in response to COVID-19.

With these foundational tools and programs in place to support our innovation and entrepreneurial ecosystem, the University has shifted its focus to strategically building the pipeline of research, innovation and technology by taking targeted and deliberate steps to collaboratively identify, develop and commercialize Hawai'i innovation and technology for resilient and sustained local and global impact with the recent launch of its Innovation Impact Challenge (IIC) Initiative. The IIC Initiative's goal is to build a sustainable platform based on University and industry/community/government (including Department of Defense) partnerships that leverage the expertise and creativity at UH, inspire cross-disciplinary

collaboration, foster the development of novel and innovative ideas and solutions for Hawai'i's challenges, and create more opportunities to impact Hawai'i (e.g. utilize Hawai'i's innovation to solve local and global challenges, create a pipeline for Hawai'i's talent to stay local, and stimulate economic development with new industry).

The University of Hawai'i annually brings in hundreds of millions in research dollars, $421.8 million for FY2019, an increase of 9.2% over the previous year across a myriad of scientific areas, creating opportunities to generate cutting edge discoveries and intellectual property (IP) that has great potential economic value as well as important societal benefits. Given the level of research funding into the university, a challenge for UH is to dramatically improve its identification of promising intellectual property and successfully translate outcomes into viable companies competing in the global marketplace. The Innovation Initiatives described above, contextualized by the evolving state Innovation Ecosystem, and the Emerging Areas core in the new MIDAAS EPSCoR, positions UH and its partners to meet this challenge.

Table III: Innovation Initiative Impacts; Key Indicators

Extramural Funding Awards FY20	$450M, increasing by $28M on FY19
Technology Transfer FY20	65 inventions disclosed, increasing from 41 in FY19
	7 patents issued, bringing 5 year total to 46
	147 active license, options
	$1.54M in technology royalties in last 5 years
	15 new start-ups supported

https://www.hawaii.edu/research/research-dashboard/

5. Summary

In summary, the EPSCoR program, Hawai'i's universities, and the innovation ecosystem are integrated in their efforts to support a prosperous and resilient future for Hawai'i. The NSF and UH investments in EPSCoR and innovation have raised our competitiveness, reputation and productivity in scientific research which translates to stakeholder-responsive, actionable information to inform decision making on the state's priorities and challenges. Technology transfer is growing, and the launch of a new statewide effort to promote data analytics across education, research, training and all economic sectors, will create jobs and further empower the state's resilience. There has never been a greater need in Hawai'i to open new avenues to well-paying jobs with global reach. The Statewide Plan's enumerated vision of Hawai'i as a *data-rich*, *data-responsive* and *data-empowered* state holds that promise. EPSCoR and Hawai'i's Universities stand ready to play their part in realizing that vision.