

THE SUNY COLLEGE OF NANOSCALE SCIENCE AND ENGINEERING (SUNY CNSE). A VIBRANT ENGINE FOR INNOVATION, EDUCATION, ENTREPRENEURSHIP, AND ECONOMIC VITALITY FOR THE STATE OF NEW YORK

EXECUTIVE SUMMARY

The College of Nanoscale Science and Engineering (CNSE) has developed into a vibrant research and educational resource for the State University of New York (SUNY) system and for the State of New York. It has become a major engine for innovation and economic revitalization of the state through the combination of sustained growth and visionary leadership--by focusing on an area of technology that is tremendously demanding technically and critically important for the future economic prosperity of New York and the nation.

To date, CNSE has been a component college of the SUNY University at Albany (UAlbany) and has prospered, to the mutual benefit of both CNSE and the UAlbany. The progressive autonomy of CNSE over the past 10 years, including its establishment as a standalone SUNY Research Foundation (SUNY RF) research center, its status within the state of New York as a unique driver of innovation and economic development, its development of pioneering integrative models of education and research, and the existing array of unique and growing corporate and university partnerships now calls for the establishment of a new degree-granting structure within the SUNY system that includes CNSE.

This new status will allow CNSE's further growth and impact by enhancing its role and its ability to move quickly and nimbly to take advantage of the many emerging opportunities, in partnership with SUNY Administration and the SUNY RF, while ensuring full accountability and complete transparency as part of a new degree granting structure.. The transition will be designed to allow for greater intellectual connectivity to UAlbany and to the entire SUNY system, and will free up the UAlbany to focus on complementary and other academic and research pursuits.

As part of a new degree-granting structure, CNSE will continue to work closely and collaboratively with UAlbany and many specific relationships will continue with that campus and, in fact, will be augmented. In addition to the current cross-disciplinary M.S. program in Nanotechnology Management (Nano-MBA) in partnership with the UAlbany School of Business, specific collaborative opportunities are evident, for example, in the areas of Public Health, Public Policy, Social Sciences, Natural and Biophysical sciences and in engineering arenas separate from but complementary in nature to nanotechnology. As part of a new degree-granting structure, CNSE will act to integrate systems thinking across SUNY, in partnership with the SUNY RF, through its combination of energetic partnering, provision of technological expertise and the modeling of exciting new educational paradigms. This document describes the status and history of CNSE and presents the rationale for taking advantage of this remarkable opportunity for SUNY.

THE SUNY COLLEGE OF NANOSCALE SCIENCE AND ENGINEERING (SUNY CNSE). A VIBRANT ENGINE FOR INNOVATION, EDUCATION, ENTREPRENEURSHIP, AND ECONOMIC VITALITY FOR THE STATE OF NEW YORK

I. CNSE. BACKGROUND AND HISTORY

The essence of nanoscale science and engineering, or as commonly referred to as nanotechnology, is the ability to manage and control the formation and assembly of individual building blocks of matter at the molecular level, atom by atom, to form macro-scale physical, biological, and chemical systems with customized properties and precise functionalities.

As such, nanotechnology has literally transformed and reshaped traditional science and engineering disciplines, including chemistry, physics, electrical engineering, mechanical engineering, materials science and engineering, molecular biology, and computer science, from individual, isolated (“silo-like”), fields into interdisciplinary, integrated (“Acropolis like”), fields within an open innovation and education paradigm.

Nanoscale science and engineering represents a modern revolution in science and technology. Its seminal importance is well documented and universally accepted by the academic and industrial science and engineering communities.¹

“Nanotechnology is the base technology of an industrial revolution in the 21st century. Those who control nanotechnology will lead the industry.” -- Michiharu Nakamura, Executive VP at Hitachi

“Nanotechnology is going to change America on a scale equal to, if not greater than, the computer revolution. Harnessing the power of nanotechnology is one of the keys to ensuring that our nation continues to be an economic powerhouse in this new century.” -- U.S. Senator Ron Wyden (D-OR)

The importance of nanoscale know-how to the U.S. research and pedagogical agendas is best captured in the multi-billion dollar National Nanotechnology Initiative (NNI), first launched by President Bill Clinton in 2001, and signed into law by President George W. Bush in 2004, which proclaims nanotechnology as “leading to the next industrial revolution.” The NNI also calls for the creation of the “laboratory and human resource infrastructure in universities and in the education of nanotechnology professionals” to prepare future generations of U.S. citizens to compete in the “innovation economy” of the 21st century.²

These conclusions are echoed by the U.S. Commission on National Security/21st Century in its Report entitled Roadmap for National Security: Imperative for Change. The report states that: “We also face an unprecedented opportunity. The world is entering an era of dramatic progress in bioscience and materials science as well as information technology and scientific instrumentation. Brought together and accelerated by nanoscience, these rapidly developing research fields will transform our understanding of the world and our capacity to manipulate it.”

¹ “Regional, State, and Local Initiatives in Nanotechnology” (Report of the National Nanotechnology Initiative Workshop, May 1-2, 2012, Portland, Oregon).

² “The National Nanotechnology Initiative” (Supplement to the President’s 2014 Budget).

I.1. THE ESTABLISHMENT AND CURRENT STRUCTURE OF CNSE

In response to the resulting rapid changes and emerging needs in the research and instructional landscapes, the SUNY Board of Trustees (BoT) unanimously approved in April 2004 Resolution 2004-41 that creates the College of Nanoscale Science and Engineering (CNSE) as a separate UAlbany academic unit headed by a Vice President reporting directly to the UAlbany President. The BoT resolution also authorized the UAlbany President and CNSE Vice President to jointly develop the autonomous administrative, programmatic, and budgetary structure necessary to enable the successful development and implementation of the CNSE vision and mission as a strategic education, research and development, and economic outreach engine for the State of New York.

The SUNY BoT action was followed by an open dialogue and extensive collaborative process between the UAlbany University Senate and CNSE faculty that affirmed an overarching and mutual commitment to a unified UAlbany faculty governance structure, and established the standards for the various degrees of autonomous CNSE faculty governance in the areas of graduate curricula, academic standing and appeal, continuing appointment and promotion, and research. The resulting CNSE Faculty Bylaws and CNSE Faculty Council Charter were endorsed by the UAlbany University Senate and CNSE Faculty Council in December 2004,³ and approved by the UAlbany President shortly after.

In 2008, and in response to the further evolution in the innovation and education landscapes, as constantly reshaped by nanotechnology, the SUNY BoT acted again to unanimously approve Resolution 2008-165 that further expanded the autonomous administrative structure of CNSE and promoted its head to the position of CNSE Senior Vice President (“SVP”) and Chief Executive Officer (“CEO”). The resolution also assigned the CNSE SVP and CEO full administrative, academic, and fiscal authority over CNSE, with said authority being fully comparable and equal to the authority exercised by a SUNY President in the administration of an assigned campus.

It additionally vested in the CNSE SVP and CEO, as part of said authority, the budgetary and fiscal authority on behalf of CNSE including, but not limited to, the management and oversight of the development, implementation, and administration of the CNSE annual budget, plans and requests; and the authority to develop and submit to SUNY the CNSE annual operations budget request and to SUNY and the State University Construction Fund (“SUCF”) the CNSE capital construction plan and budget request, separately and independently from UAlbany’s annual operations budget request and capital construction plan and budget request.

The second SUNY BoT action was followed by an overwhelming vote by the UAlbany University Senate and a unanimous vote by the CNSE Faculty Council in support of the BoT Resolution 2008-165. The UAlbany University Senate and the CNSE Faculty Council also worked jointly on a revised set of standards for the various degrees of expanded autonomous CNSE faculty governance.

Concurrently, the UAlbany President and CNSE SVP/CEO developed, as authorized by SUNY BoT resolution, a top down realignment of the titles and associated designations of the CNSE executives to more accurately reflect their increased duties and responsibilities, and better position them to be at par with their counterparts within the global corporate partners, federal

³ UAlbany University Senate Resolution Number 0405-01R (December 6, 2004).

agencies, national laboratories, research universities, and private business collaborators. As a result of these actions, independent CNSE research, academic, admissions, financial, and human resources offices were established, all headed by Vice President level officers, including CNSE Vice President for Research, CNSE Vice President for Academic Affairs, CNSE Vice President for Finance and Fiscal Responsibility, and CNSE Vice President for Student Affairs.

I.2. CNSE. A WORLD-CLASS EDUCATIONAL PIONEER

The successful capitalization on the tremendous potential of nanotechnology and its various disciplines requires the development and implementation of innovative instructional and training programs to prepare qualified scientists and engineers at all academic levels, from K-12 through graduate education. This assessment is supported by practically every study, blueprint, report, and analysis published by every governmental body, corporate organization, academic entity, think tank, and cross-organizational panel across the globe--including the National Science Foundation, which forecasts the need for more than two million nanotechnology educated professionals at all employment levels in the U.S. by 2015, with another five million nanotechnology jobs being required worldwide in support fields and disciplines.

Accordingly, and as stated in the SUNY BoT resolutions, the overarching educational mission of CNSE is to “enable the discovery and dissemination of fundamental knowledge in the emerging interdisciplinary fields of nanotechnology and provide the citizens of New York with a comprehensive education of the highest quality.”

In accordance with its vision and mission, CNSE has developed a multi-phase, long-term strategic plan that reshapes the traditional departmental structure into four constellations of scholarly excellence in research and development, education, technology deployment, and economic outreach. Conceived as catalysts that encourage and stimulate cross-disciplinary education and research initiatives, these “think tanks” embody the fundamental intellectual underpinnings of nanotechnology as follows:

Nanoscale Science: The observation, identification, description, discovery, experimental investigation, and theoretical interpretation of nanoscale phenomena.

Nanoscale Engineering: The application of nanoscale science principles to practical applications, such as the atomic scale design, manufacture, and operation of efficient and functional structures, machines, processes, and systems.

NanoEconomics: The formulation, study, and analysis of the economic and business principles underlying the development and deployment of nanoscale know-how, products, and systems.

NanoBioscience: The application of nanoscale scientific concepts and principles to the study of biological, biomedical, and medical procedures, practices, structures, systems, and organisms.

At the graduate level, CNSE currently offers two separate graduate curricula, one in nanoscale science and the other in nanoscale engineering, leading to two separate sets of Ph.D. and M.S. degrees. CNSE has also implemented a dual cross-disciplinary M.S. program in Nanotechnology Management (Nano-MBA) in partnership with the UAlbany School of Business and a joint M.D.-Ph.D. program with selected SUNY Medical Schools, e.g., SUNY Downstate Medical Campus. At the undergraduate level, CNSE currently offers two separate

undergraduate curricula, one in nanoscale science (beginning in 2011) and the other in nanoscale engineering (beginning in 2012), leading to the Bachelor's degree in nanoscale science or nanoscale engineering.

The CNSE degrees are designed to prepare students to be leaders in the various interdisciplinary fields of nanotechnology, in accordance with the national science and engineering roadmap for competitiveness in the global economy of the 21st century:

“An adequately trained scientific workforce is essential for creating and transforming the industries that will realize the benefits of nanotechnology”⁴

Furthermore, as outlined in the National Nanotechnology Initiative roadmap, the Mission Review Memorandum of Understanding between SUNY and UAlbany,⁵ the outcomes of the UAlbany 2006 Strategic Compact Planning,⁶ and the recommendations of the UAlbany Board of Visitors (BOV),⁷ and in accordance with its strategic plan, the CNSE is currently planning to advance two nanobioscience curricula, one at the graduate level, the other at the undergraduate level, leading to Ph.D., Masters, and baccalaureate degrees in nanobioscience. The two degrees are synergistic and complementary in scope and objectives, and build on each other's strengths to maximize return on investment and ensure paramount effectiveness in advancing SUNY's educational mission and overarching goals. The curricula proposed are intended to attract and retain a significant portion of the undergraduate student population that is presently inaccessible to SUNY and most of the private institutions of learning in New York State. This inaccessibility is driven by the lack of the interdisciplinary nanobioscience degrees that are sought by this rapidly growing sector of the SUNY clientele.

In a nutshell, through its pioneering portfolio of graduate and undergraduate programs in nanoscale science and nanoscale engineering and constellations in nanoeconomics and nanobiosciences, CNSE is ensuring that SUNY retains its global academic prominence within the highly competitive arena of nanotechnology, and continues to be highly responsive to the increasingly diversified needs and interests of the university's ever evolving student clientele.

At the undergraduate level, the success of the CNSE strategy is perhaps best illustrated through the quality of its entering undergraduate classes in nanoscale science and nanoscale engineering, as reflected by average SAT combined scores above 1350, on par with top science and engineering schools such as MIT and Stanford. It should be noted that, since the start of the CNSE undergraduate degree offerings in 2011, the number of undergraduate students has tripled each year, and is expected to exceed 200 undergraduate students in Fall 2013, and reach 500 undergraduates by 2017. By design, all of the CNSE undergraduate students are New Yorkers.

At the graduate level, the success of the CNSE strategy is documented by the fact that over 90% of the CNSE Ph.D. and M.S. graduates remain in New York and are employed by the “Who's Who” in the nanotechnology industry in very high paying jobs across the State.

⁴ “Report to the President and Congress on the Fourth Assessment of the National Nanotechnology Initiative” (Executive Office of the President, President's Council of Advisors on Science and Technology, April 2012)

⁵ “Memorandum of Understanding Between the University at Albany and the State University of New York,” submitted June 2006 and approved November 2006.

⁶ The outcomes of the UAlbany 2006 Strategic Compact Planning Process, as endorsed by the UAlbany University Senate and adopted by the University President.

⁷ “BOARD OF VISITORS: Report of Observations and Recommendations,” the University at Albany, June 2006.

I.3. CNSE. AN INNOVATION CATALYST AND ECONOMIC DEVELOPMENT ENGINE FOR NEW YORK

In accordance with its vision and mission, CNSE is also acting as a novel innovation resource and deploying a new business paradigm for research and development (R&D), technology deployment, business development, and economic outreach in nanotechnology and nanotechnology-enabled industries of the 21st century. Products and services under research-based investigation include: nanoelectronics (multi-purpose and densely-functional laptops, desktops, servers, and supercomputers; tether-free automotive and consumer electronics; smart sensors for real-time closed-loop monitoring and control; three-dimensional interactive computing and high-definition virtual-reality gaming); homeland defense and security; renewable green energy; nanomedicine and health care; and transportation.

A key aspect of the CNSE mission is to assemble and deploy the critical mass of vertically and horizontally integrated industry-university-government consortia and public-private partnerships to convert enabling nanotechnology innovations and atomic scale scientific breakthroughs into real business opportunities and revenue-generating ventures within a technically aggressive and fiscally leveraged technology development and deployment environment. As such, CNSE is serving as a global resource for comprehensive R&D and prototyping of the highest caliber, leading to the discovery and dissemination of fundamental knowledge concepts and new frontier scientific principles in the emerging interdisciplinary fields of nanotechnology.

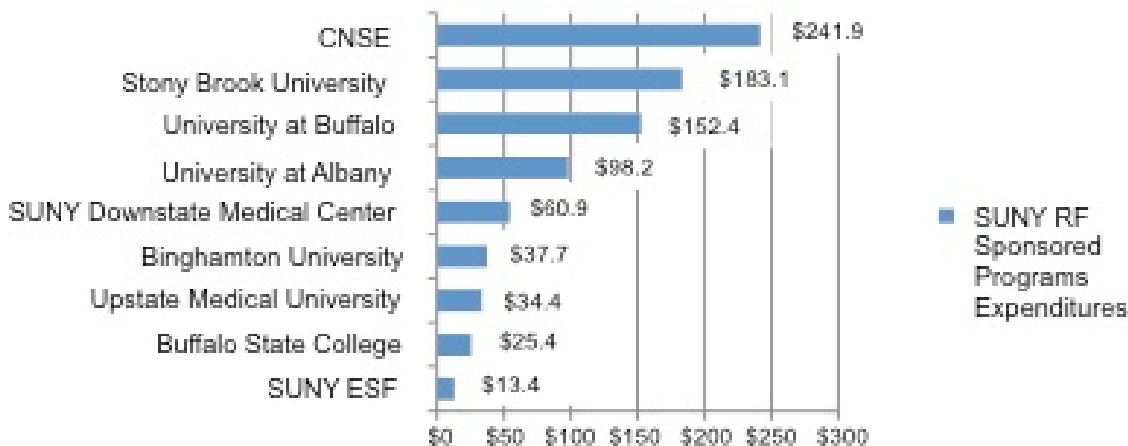
In so doing, the CNSE multiplex of open innovation and higher learning is providing the impetus needed to attract the high-tech industry to locate, relocate, and expand in the State of New York by affording the industry access, within an open innovation paradigm, to world-class intellectual assets, state-of-the-art-facilities, and highly-skilled, highly-educated workforce in next generation scientific disciplines--all essential prerequisites for high-technology companies to compete successfully in the global innovation-driven economy of the 21st century.

The success of the current CNSE business model and associated outcomes ("business of academics model") is perhaps best documented by the creation of a highly successful "New York Nanotechnology Innovation and Commercialization Corridor," stretching from the IBM Hudson Valley Research Park in East Fishkill, through the CNSE Albany NanoTech Complex, to the Global Foundries computer chip fabrication plant ("MegaFab") in Saratoga County. This novel model ensures academic excellence, while driving entrepreneurial innovation, economic vibrancy, and high technology employment growth.

Within this paradigm, the CNSE Albany NanoTech Megaplex is the most advanced innovation and education hub of its kind at any university in the world. With over \$15.0 billion in private and public investments, the 1,125,000-square-foot complex has attracted corporate partners from around the world and offers faculty and students a one-of-a-kind academic experience. CNSE includes the only fully integrated, 300mm wafer and 450mm wafer, computer chip pilot prototyping and demonstration lines within 135,000 square feet of Class 1 capable cleanrooms. The Albany NanoTech Megaplex also houses 3,100 scientists, researchers, engineers, students, and faculty from CNSE, SUNY, many of the top flight institutions of higher learning in the U.S., as well as global corporations including IBM, SEMATECH, GlobalFoundries, Intel, Toshiba, ASML, Applied Materials, Nikon, Tokyo Electron, and SEMATECH. An expansion currently underway will increase the size of CNSE's Albany NanoTech complex to over 1,750,000 square feet, including over 200,000 square feet of Class 1 capable cleanroom space, to house over 4,500 scientists, researchers, engineers, students, and faculty by mid-2017.

With respect to SUNY and the SUNY Research Foundation (SUNY RF), CNSE is a critically important contributor to their academic, education, and research enterprises, and to their regional, statewide, national, and international standings and reputation. In addition to the educational and innovation benefits outlined earlier, CNSE has exponentially strengthened SUNY's and the SUNY RF's research productivity, performance and profile. A case in point are the CNSE externally sponsored annual research expenditures, as reported by the SUNY RF, which increased from \$4,743,137 in 2001 to \$241,900,000 in 2013--over 5000% increase that does not include additional external funding contributions to the CNSE endowment fund or contracts and grants to the Fuller Road Management Corporation (FRMC) for construction, capital acquisitions, and rent and access fees to facilities and laboratories. The figure below shows the RF-reported research expenditures for calendar year 2012 (note that other non-RF expenditures at the University at Albany are not included in the diagram).

Sponsored Program Expenditures by Location
 Jan. 1, 2012 – Dec. 31, 2012
 (in millions)



(Source: SUNY RF)

In fact, The SUNY RF projects that the CNSE externally sponsored annual research expenditures will top \$300 million in 2013, or approximately 1/3 of the SUNY RF entire externally sponsored funding portfolio. The CNSE remarkable growth and success as innovation engine for SUNY and SUNY RF is largely attributed to its unique paradigm of the "business of academics," which safeguards the faculty academic freedom to innovate and educate while ensuring accountability and entrepreneurship.

With respect to New York State, the effectiveness of CNSE as a statewide economic growth engine is perhaps best documented by the universal recognition of CNSE as the driver in the creation and retention of over 13,500 nanotechnology jobs as of December 2012 across New York (primarily upstate). According to the Federal Bureau of Labor Statistics and TechAmerica, the average annual wage in New York per such job was \$91,000 in 2012, 50% more than New York's average private sector wage. Accordingly, the CNSE economic development paradigm is therefore currently driving over \$1.2 billion dollar yearly into the state economy in wages alone.

A case in point is the visit by President Barack Obama in May 2012 to the CNSE Albany NanoTech Multiplex. During his visit, the President credited CNSE with the exponential boom in high tech jobs in the Capital Region and stated: "...Now, I want what is happening in Albany to happen all across the country, in places like Cleveland, Pittsburgh, Raleigh...."

I.4. CNSE CURRENT ADMINISTRATIVE AND BUDGETARY AUTONOMY. RATIONALE AND BENEFITS

The CNSE success to-date would have been impossible without its autonomous management platform and self-governing operational blueprint that are at the core of the success of the CNSE paradigm of public-private partnerships for education, innovation, and economic development. The CNSE current management platform and operational blueprint combine an academic atmosphere that promotes creativity and discovery with a business environment that drives entrepreneurship and accountability.

On the academic side, CNSE replaced the traditional "silo" type departmental structure with interdisciplinary faculty constellations that act as catalysts for cross-disciplinary innovations in education and research, and coupled it to a faculty performance and evaluation system that rewards entrepreneurship, outreach to industry, and timely delivery of scientific and technological solutions.

On the business side, CNSE has implemented a corporate-like administrative and management structure, which is maintained through two private, not-for-profit, organizations that provide the entire array of facilities and infrastructure services, fiscal resources, and accounting means in support of the CNSE programs, centers, and partnerships. These two organizations are the SUNY RF and FRMC.

The SUNY RF is a private, not-for-profit (501(c)(3)), educational corporation with the primary responsibility to provide fiscal administration and accounting support for externally funded contracts and grants for and on behalf of the State University of New York, including CNSE and its centers and consortia. The SUNY RF facilitates research, education, and service at 30 state-operated SUNY campuses, pursuant to an agreement entered into in 1977 with SUNY. The SUNY RF is designed to balance the administrative flexibility and programmatic creativity to respond quickly to the special demands of sponsored programs, with the fiscal and legal oversight responsibilities associated with SUNY affiliation. A board of directors oversees the operations of the SUNY RF. The board consists of representatives from the various SUNY stakeholders, including campus and system administration, as well as leaders from private business, the academic community, and industry.

FRMC is a private, nonprofit (501(c)(26)) "real-estate holding" corporation that ensures that the facilities and infrastructure that house CNSE and its private and public partners are built and operated in accordance with stringent industrial standards and prevailing business practices. The charter of FRMC is to plan, design, develop, construct, own, maintain, and lease R&D and commercialization buildings and facilities at the CNSE Albany NanoTech Complex in support of the CNSE strategic programs, R&D partnerships, and commercialization consortia. FRMC conducts its business by holding title to property, collecting income from the property, and managing the property on behalf of CNSE. Currently, FRMC is a partnership between two members, namely, the SUNY RF and the University at Albany Foundation, each with the responsibility to appoint 5 of the 11 board members. It is overseen by a Board of Directors currently chaired by the CNSE Senior Vice President (SVP) and Chief Executive Officer (CEO) and consists of business, industry, and corporate leaders.

Within this overall framework, the CNSE organization and staffing are closely aligned along an academic structure and a separate, yet complementary, business structure. By design, a certain degree of overlap exists across the two management structures in something of a “matrix” approach to foster collaborative and flexible teaming while eliminating bureaucratic obstacles. Oversight of both structures is the responsibility of the CNSE CEO, who currently holds the concurrent title of SVP, and who reports directly to the Chancellor. The CNSE SVP and CEO has a high degree of authority, and is responsible for all decisions regarding overall technical, strategic, and business direction, including coordination and communication of directions and priorities with the CNSE academic and corporate partners.

With this unique management platform and implementation blueprint as backdrop, CNSE has been able to achieve a critical set of competitive strengths that have driven its success to-date. In particular, CNSE has established:

- An enabling foundation of intellectual assets that covers the entire spectrum of R&D know how and the technology development skill set necessary to support the formulation and deployment of cutting edge innovations in nanotechnology and nanotechnology-enabled disciplines of the 21st century.
- The most advanced nanotechnology laboratory and physical infrastructure of any university in the world, including two fully-integrated, 300mm wafer and 450mm wafer, processing lines for the 14nm device node and beyond housed within state-of-the-art Class 1 capable cleanroom facilities built and operated according to stringent industrial know-how, controls, and standards.
- An attractive and effective package of sustained and focused New York State and SUNY financial investments and matching fund incentives that effectively reduce and even minimize corporate R&D expenditures, thus placing CNSE’s industrial partners in a highly competitive business advantage versus other international corporations.
- An on-site “ecosystem” on the CNSE Albany NanoTech Complex and consisting of a critical mass of global materials and chemical suppliers, equipment fabricators, and computer chip manufacturers that cover every stage of the technology development and product commercialization “food chain,” thus enabling a “soup to nuts” product development and deployment continuum.
- A flexible and responsive R&D and prototyping environment with a leveled playing field where all members of the public-private partnership are treated equally and consistently. This environment is designed to protect each corporate partner’s confidential research priorities, individual intellectual property needs, and specific business security concerns, while encouraging pre-competitive teaming at “business speed”--that enables cross-company partnerships to flourish. This environment, with major material, chemical, and equipment suppliers teaming with their large IC customers in proximity to competitors and vice versa, has been highly successful in accelerating product development and creating tangible business value to attract further corporate investment to CNSE.
- Administrative and financial ability to move quickly and responsively in alignment with corporate technology roadmaps and business development strategies. The CNSE SVP and CEO is supported by a separate and tailored management structure that manages and

marshals resources toward its mission, while remaining responsive to the needs and speed of corporate partners, and ensuring accountability and transparency as a SUNY unit.

- Designation, in 2009, as a standalone SUNY RF campus, with a CNSE RF Operations Manager (OM) reporting directly to the President of the SUNY RF. This structure is of paramount importance to the establishment and management of public-private partnerships, as it enables the CNSE SVP/CEO and the CNSE top executives to work closely and hand-in-hand with the SUNY RF President and top executives to advance the SUNY educational and innovation portfolios in nanotechnology and nanotechnology-enabled disciplines.
- A corporate-like administrative and management structure that is designed to reflect industry models within the “business of academics,” including capable business executives at all management levels, and industry trained professionals and engineers to operate and run the CNSE facilities.

II. SEPERATING CNSE: DRIVERS, RATIONALE, AND BENEFITS

II.1. THE NEW NAONATECHNOLOGY ENABLED GLOBAL ECONOMY. A RAPIDLY CHANGING LANDSCAPE

The current CNSE autonomous operational blueprint has been an essential ingredient in the success of its educational, innovation, and economic outreach initiatives in support of SUNY, the SUNY RF, and the State of New York.

However, as nanotechnology continues to revolutionize the fundamental building blocks of the world’s economy, the complexity, cost, and multiplicity associated with nanotechnology innovations are generating an even more radical transformation in the prevailing national and international education, R&D, and commercialization paradigms. This radical transformation necessitates a further restructuring of CNSE’s current management and administrative functions. This restructuring will lead to CNSE becoming part of a new degree-granting structure within SUNY(in addition to its present status as a standalone SUNY RF campus), with UAlbany remaining a strategic partner campus, as discussed below.

From an educational perspective, the interdisciplinary nature of the nanoscale discovery and innovation paradigm is making the conventional science and engineering operational model, such as separate physics, chemistry, and biology departments, increasingly outmoded. They are being replaced by cross-disciplinary nanoscale academic fields that embody the fundamental intellectual underpinnings of nanotechnology and are designed as innovative instructional and training programs to prepare qualified scientists and engineers at all academic levels, from K-12 through graduate education, for the nanotechnology enabled economy of the 21st century.

From an R&D perspective, the complexity and multiplicity involved in the identification, screening, and selection of new innovations and resulting nanotechnology-enabled products represent a daunting challenge. This challenge is driving a sweeping change in the academic and industrial technology development and deployment circles away from the conventional, individual university- or company-centric model to the more intellectually open “Acropolis” approach.

From a financial perspective, the cost associated with the demonstration, deployment, and manufacturing of nanotechnology discoveries will continue to rise exponentially, a trend that is already placing tremendous strains on the fiscal integrity and business competitiveness of even the largest academic institutions and global corporations. Illustrative are the investments required per computer chip node, which are projected to nearly triple in less than five years. Current projections for the total cost for design, process R&D, and one manufacturing fabrication plant predict a rise from ~\$4.0-\$5.0B for the 22nm chip platform to ~\$12.0-\$15.0B for its 10nm node counterpart. This exponential cost increase “...creates elitism with a few haves and most have nots.....” in the nanoelectronics university and corporate communities.

The convergence of these evermore intricate technological obstacles and taxing financial constraints are forcing even the handful of remaining academic and corporate “haves” to participate in inter-disciplinary, multi-organizational, vertically and horizontally integrated R&D consortia centered on a state-of-the-art, multi-dimensional, “Switzerland” type business model. Such a model ensures the pooling of the intellectual assets and physical resources necessary to guarantee timely technology demonstration and delivery, in a neutral setting, while providing the leveled playing field required by each consortium participant to leverage its investments and protect its privacy and confidentiality.

In this context, the traditional prevailing U.S. business model of “...if it is worth it, industry will fund it...” is being severely compromised by the technical and financial realities of commercial competitiveness in a global marketplace. The problem is further compounded by foreign governments’ massive investments in new science and engineering campuses coupled to enormous business incentives and commercial subsidies to create a highly attractive environment for the attraction and retention of global R&D and manufacturing corporate “anchor tenants.”

One striking example among many is what is commonly being referred to as “the ultimate subsidy,” wherein Hubei Province in Mainland China has invested \$5 billion to construct a 300mm wafer fab and outfit it with an entire manufacturing line, with the Shanghai-based foundry chipmaker Semiconductor Manufacturing International Corp. being simply asked to “manage the facility” without incurring the costs in construction and outfitting.

The predominance of this new “burden-sharing” economic development paradigm results in significant long term implications to New York State’s strategic and economic interests, including the availability of a scientifically and technologically competitive university infrastructure, coupled to the establishment of a financially stable and fiscally sustainable high technology industrial base to drive a diversified and vibrant state economy.

II.2. THE NEW NEW YORK. A NEW PARADIGM FOR INNOVATION, EDUCATION, AND ECONOMIC

With these daunting realities, the long-term viability of the New York State economy depends on the convergence and alignment of key strategic, technical, and financial drivers that combine educational excellence, with technological competitiveness, and commercial success. The technical factors can be grouped into four major criteria: innovative educational assets; cutting edge research capabilities; state-of-the-art infrastructure supporting an integrated process flow for development and deployment; and demonstrated pathways for technology transfer to manufacturing and commercialization.

The technical considerations above provide a necessary but not sufficient condition for success. In addition, two business criteria must be met: tight coupling to an integrated “ecosystem” of

small, medium, and large design outfits, material suppliers, and equipment manufacturers that form the critical mass or “food chain” of technology development and commercialization building blocks; and a leveraged and cost effective fiscal strategy that maximizes return on investment and creates a healthy long term financial platform to support the steadily increasing investment requirements of future nanotechnology manufacturing nodes.

To this end, Governor Andrew Cuomo has developed and is beginning the implementation phase of the “New New York” strategic investment policy to position New York as the global leader in the innovation economy by exploiting the combined intellectual and physical resources of the state’s top-flight research universities and leading global corporations to establish technically and financially leveraged public-private partnerships for technology development and economic outreach. The Governor’s strategy couples these partnerships to a continuum of novel economic incentive initiatives that include the Regional Economic Development Councils (REDCs), SUNY2020, the Innovation Hot Spots, high tech incubators, the Innovation New York Network, and the recently-announced groundbreaking Tax Free NY program.

As part of this strategic investment policy, the Governor has identified nanotechnology as a top investment priority for the State of New York and has promoted the concept of the “nanotechnology innovation and education ecosystem,” with CNSE acting as the linchpin and primary driver for an upstate nanotechnology education, innovation, and commercialization hub. As a result, CNSE is being tasked, in partnership with the SUNY RF, with the establishment of a coordinated critical mass of R&D and deployment that integrates three anchor components: (i) intellectual knowledge, (ii) physical assets, and (iii) networks (partnerships) targeting nanotechnology-enabled growth industries. Such a strategic approach would seek to link local academic, business, and economic resources for each region of upstate with complementary CNSE assets and capabilities to establish a “21st Century High Technology Erie Canal” that hosts vertically-integrated supply-chain partnerships that stabilize and expand upstate’s business foundation and industrial base.

On the educational and workforce training front, CNSE is being tasked with the development and implementation of a state-wide workforce development and educational outreach mission that aims to assemble and deploy the critical intellectual and physical resources necessary to support appropriate SUNY institutions and not-for-profit organizations in the creation of the complete instructional continuum from K-12, through certificate level skills training, and two- and four-year curricula, leading to the full array of nanotechnology-enabled degree granting programs and opportunities. The initiative will also include the design and execution of specialized educational and training programs that target the attraction, retention, training, and retraining of students and workers from underrepresented social groups in science and engineering.

On the technology deployment and economic outreach front, CNSE, in partnership with the SUNY RF, has been tasked with a business development and economic outreach mission to establish and retain across upstate the critical mass of intellectual and physical resources and capabilities including clusters of technical and engineering units from equipment, materials, and component suppliers, research and development teams, and manufacturing groups necessary to ensure optimum execution of nanotechnology-enabled research and manufacturing programs, leading to the creation and retention of high-paying, high-technology jobs and ensuring maximum return on investment for the State of New York.

As a result, CNSE has been engaged in a strategy in partnership with the SUNY RF for economic revival across upstate New York to establish vertically integrated supply-chain

partnerships in targeted nanotechnology-enabled growth industries. Current CNSE-SUNY RF initiatives include:

- In Utica-Rome, the “Computer Chip Commercialization Center,” a \$350 million partnership with SUNYIT and the Mohawk EDGE to construct and operate a state-of-the-art education, innovation, and technology transfer hub for system-on-a-chip technologies.
- In Malta, the “Solar Energy Development Center,” a \$400 million public-private partnership that houses the U.S. Photovoltaic Manufacturing Consortium (U.S. PVMC), which was designated by the U.S. Department of Energy in a national competition under the U.S. Sunshot Initiative.
- In Canandagui, the former Center of Excellence in Infotonics was acquired and rebranded as the “CNSE Smart System Technology and Commercialization Center.” As a CNSE R&D Center, the CNSE STC focuses on the development and deployment of smart sensor systems for applications in the energy, defense, and transportation industries.
- In Rochester, a former Kodak cleanroom facility was acquired and rebranded the “CNSE Solar Manufacturing Development Center,” a \$100 million initiative to construct and operate a crystalline silicon photovoltaic development line in support of the R&D and commercialization needs of small and medium size New York solar companies.

In accordance with the Governor’s “New New York” strategy, CNSE is currently in the process of launching, in partnership with the SUNY RF, critical expansions and major additions in its educational programs, research partnerships, and upstate economic outreach. Accordingly, the success of the resulting CNSE implementation roadmap requires restructuring of its current management and administrative functions to establish a degree-granting structure that includes CNSE with UAlbany as a strategic partner campus.

III. CNSE As PART OF A NEW DEGREE STRUCTURE. ADVANTAGES AND BENEFITS

The establishment of CNSE as part of a new degree-granting structure with full administrative and financial independence and with UAlbany as a partner campus has a significant number of strategic, programmatic, and educational advantages to the citizens of the State of New York, and the faculty, students, staff, and various stakeholders of SUNY, UAlbany and CNSE. The highly positive implications include:

- Establishing the SUNY CNSE, as a unique world class education and innovation resource, focused on nanotechnology and nanotechnology-enabled academic disciplines, for the SUNY system and the entire State of New York, with scholarly excellence and affordable education for the state citizens, in accordance with the “Power of SUNY” strategic blueprint. SUNY CNSE will serve as an effective tool and streamlined integrative vehicle for SUNY and the SUNY RF to develop and implement system-wide education and innovation opportunities that are not expected to require additional state funding, and that will be financed through the CNSE assets, capabilities, and global network of private and corporate partners.
- Transforming CNSE into a true statewide education, innovation, and economic outreach resource with the ability to partner more closely with SUNY System Administration, the

SUNY RF, and other SUNY campuses to quickly and effectively manage and marshal resources toward the “Power of SUNY” statewide mission, integrating across and adding concrete value to the activities of all other SUNY campuses, while providing accountability and transparency directly to SUNY and the SUNY RF.

- Ensuring consistency and reciprocity between the CNSE management and administrative structures on the SUNY and SUNY RF sides, while eliminating any perceived ambiguity in SUNY student clientele and, importantly, reducing administrative complexity for corporate stakeholders who seek simplified and authoritative decisional systems. The establishment of CNSE as its standalone RF research center has, for example, been of paramount importance to the formulation and deployment of public-private partnerships, as it enables the CNSE SVP/CEO and the CNSE top executives to work closely and hand-in-hand with the SUNY RF President and top executives to advance the SUNY educational and innovation portfolios in nanotechnology and nanotechnology-enabled disciplines.
- Elevating the SUNY nanotechnology initiative under a new structure that includes a system-wide role sends an unequivocal and clear message to all stakeholders about the status and importance of the state nanotechnology initiative to SUNY, in accordance with Governor Andrew Cuomo’s identification of the “nanotechnology innovation and education ecosystem” as a highest state priority. Ensuring the long-term stability of CNSE as an integral component of the SUNY system will significantly enhance the ability to recruit leading faculty candidates and topmost graduate and undergraduate students, and assure the implementation of expanded funding opportunities.
- Identifying a strategic partnership (to be fully defined over the next year) between SUNY CNSE and UAlbany that will lead to mutual benefits resulting from the diversity (and complementarity) in vision, mission, objectives, and culture between the two organizations. Leadership at UAlbany will be able to take optimal advantage of both the proximity and strategic opportunity afforded by CNSE and its statewide mission. Specific collaborative opportunities are evident, for example, in the areas of Public Health, Public Policy, Social Sciences, Natural and Biophysical sciences and in engineering arenas separate from but complementary in nature to nanotechnology.
- Allowing CNSE to streamline the academic and business structures at its various sites in Albany, Utica, Malta, and Rochester, and eliminate any current redundancies that are mandated by the need to maintain separate administrative operations at those sites. This streamlining of operations will lead to significant reduction in overhead and increased return on investment (ROI). It is not anticipated that the establishment of CNSE as part of a new degree-granting structure will require additional SUNY operating funds.
- Enabling CNSE to work directly with SUNY System Administration and SUNY campuses across upstate to develop and implement statewide workforce development and educational outreach programs, in accordance with the “Power of SUNY” roadmap.
- Empowering CNSE to build a closer partnership with the SUNY RF to achieve significantly higher research productivity and externally sponsored grant performance. It is anticipated that CNSE’s externally sponsored annual research revenue, as managed and reported by the RF, would increase at a faster rate than under the current structure and could hit \$500 million by as early as 2015.

It is worth noting that the internal CNSE consultation process has been completed, and the CNSE executives, faculty, staff, and students enthusiastically and unequivocally support a new structure for CNSE, with UAlbany as a partner campus. This resounding endorsement is documented by a unanimous vote by the CNSE Faculty Senate endorsing a resolution to that effect. The CNSE faculty and staff also circulated a petition that gathered over 350 votes (the lion share of the CNSE faculty and staff) also in favor of the establishment of CNSE as a standalone SUNY campus.

IV. CONCLUSIONS

This document speaks to the rationale for SUNY establishing a new degree-granting structure that includes CNSE in accordance with all applicable rules and regulations. The first of its kind in public higher education. This is an historic step, consistent with and reaffirming of the evolution of CNSE over the past decade. The new CNSE will be supportive of all other campuses in the system, and will work to forge an even more enhanced strategic partnership with UAlbany. The future of SUNY CNSE will be purposefully designed to accelerate New York's economic revitalization and the development of needed "New Yorker skills" through world-class educational experiences, in full accordance with Governor Andrew Cuomo's New New York innovation roadmap. The transition process will be designed to underpin the SUNY Board of Trustees and Chancellor's strategic vision: The Power of SUNY.

A conceptual framework for a potential agreement in principle does exist between CNSE and UAlbany, subject to approval by the SUNY Board of Trustees. If the SUNY Board of Trustees authorizes the implementation of this conceptual framework, many operational details will need to be defined through a careful collaborative dialogue and thoughtful consultation. The next step is to empanel a working team of internal experts from SUNY Administration, SUNY RF, CNSE, and UAlbany to rapidly define the needed roadmap of actions and activities in the areas of academics, governance, strategic planning, research, partnerships, and innovation.

A working group (see Attachment I), appointed by Chancellor Nancy Zimpher, was charged with reviewing the SUNY-UAlbany-CNSE discussions that have taken place to date. The working group unanimously recommends that the SUNY Board take this step, embrace the concept laid out in this document as part of a framing vision, and formally announce its intention to move forward.

June 13, 2013

Attachment I

Working Group Membership

The working group consisted of the following members (listed in alphabetical order):

Michael Castellana, Chair, University at Albany Council; President and CEO, SEFCU.

Henrik Dullea, Member, SUNY Board of Trustees; Vice President for University Relations Emeritus, Cornell University.

Angelo Fatta, Member, SUNY Board of Trustees; Founder and CEO, ANSECO Group.

Dean Fuleihan (CNSE), CNSE Executive Vice President for Strategic Partnerships; Executive Director of the Nanotechnology Innovation Institute.

Andrew Kennedy (Governor's Office), Assistant Secretary for Economic Development.

Tim Killeen (SUNY and RF), Vice Chancellor for Research, SUNY; President, SUNY Research Foundation.

Fardin Sanai (UAlbany), Vice President for University Development.

The working group was staffed by Stacey Hengsternan, Assistant Vice Chancellor for Government Relations.