Princeton University's Testimony to the NJ Biotechnology Task Force

January 25, 2018

Thank you for inviting me to speak to the New Jersey Biotechnology Task Force today. I am Anne-Marie Mamar, Executive Director of the Princeton Entrepreneurship Council, which is the advisory and coordination body on entrepreneurship programs at Princeton University. We work with many different groups around campus, and my remarks represent the collaborative input of my colleagues from the Office of Corporate Engagement, the Office of Technology Licensing, Office of Public Affairs, the Keller Center, and others.

Last year, the University released a strategic framework that prioritizes, among other things, new and improved research facilities and space to accommodate academic partnerships with the corporate, government and nonprofit sectors in an expanded innovation ecosystem. Among the objectives of this plan, as Princeton President Chris Eisgruber describes, is "to improve Princeton's connection to the innovation ecosystem". So, I am pleased to have this opportunity to share with you what Princeton is doing.

President Eisgruber stated in his 2017 State of the University address that:

Technological change has increased the importance of the surrounding innovation ecosystem in achieving Princeton's teaching and research mission: our faculty increasingly find that connections to that ecosystem enhance their ability to produce interesting research about fundamental questions, and students and faculty alike seek connections to that ecosystem to leverage the impact of their learning. Princeton must develop its campus and its programs in ways that cultivate and expand both the surrounding ecosystem and our connections to it.
Now, to provide some context - with approximately 800 tenure-track faculty members, 5,500 undergraduate students and roughly 3,000 graduate students, Princeton University is a fraction of the size of Rutgers and many of our other outstanding research university counterparts in the country. And we have no medical school, no law school and no business school. However, we do have internationally renowned academic departments engaging in both foundational and translational research. But, perhaps most important to understand about Princeton, is its unofficial motto, “In the Nation’s Service and the Service of Humanity”. It is through this lens that decisions and plans are made at Princeton.

In other words, Princeton is committed to life sciences entrepreneurship, industry engagement and technology licensing. Princeton is committed to connecting with the innovation ecosystem in New Jersey -- because these connections advance the University’s mission by bringing knowledge and discovery to bear on social and economic problems.

As perhaps we all know already, 2017 was a breakout year of life sciences and healthcare investments. PitchBook’s 4Q17 review reported that $17.9 billion was invested in life sciences companies last year – an increase of 48% over 2016 numbers and an increase of 21% over the previous record set in 2015. But the report also pointed out some important trends which should be noted - as they say ‘Technology is driving the future’. This is shown in the notable increase of technology in the life sciences sector. So while there were some very large healthcare deals in 2017, there was also an increase in generalist investors making smaller investments in life sciences companies that have strong data science components.

Princeton has real strength in hard sciences -- chemistry, biology, chemical engineering, and material sciences. And we also have great strength in data science and computer science. Our group focusing on Computational Biology, which includes bioinformatics, functional genomics and immune system modeling, is just one example of how Princeton University, and the state of New Jersey, is poised to take an active role in this trend toward integrating computational work into life sciences innovation.

Princeton University - Testimony to NJ Biotechnology Task Force - January 25, 2018
In 2016 Princeton began to translate its commitment to fostering entrepreneurship into strategic additions to the staff. The Princeton Entrepreneurship Council was officially formed at that time, and I was brought into the University two years ago. I have a staff of five people committed to engaging and supporting entrepreneurship and innovation on and off campus. Our two main areas of focus are: 1) to engage the alumni community around entrepreneurship and innovation, and, 2) to engage with others on campus and in New Jersey to build the local ecosystem.

Some of our alumni engagement programming includes:

- A small seed fund, which invests in alumni who are less than 5 years from graduation. In three years, $1.75 million has been invested in 25 companies. However, of those 25 companies, only one is currently based in New Jersey. Most of our companies are based in New York City or in Silicon Valley, which are more interesting places for millennials.

- Another program we run are VC Roadshows, where we competitively select a small number of alumni and faculty startups and then we take them on a curated visit to top VC firms. Our first VC Roadshow was to Silicon Valley, and resulted in money being invested. Our next VC Roadshow will be in New York City.

- And, most relevant to this discussion, I am closely involved in the creation of the newly opened Princeton Innovation Center Biolabs.

Princeton Innovation Center Biolabs is a 31k square foot wetlab/drylab incubator located three miles from our main campus, on the Forrestal Campus. One thing that I think is important about the new Center is that it welcomes founders who have relationships with the university and also founders who do not have any relationship with the university. We have recognized that we cannot create a vibrant entrepreneurial ecosystem for our faculty and graduate students without the involvement of others in the ecosystem.

We have contracted with Biolabs, a professional lab management group based in Cambridge, Massachusetts, to run this facility. In evaluating partner organizations to
manage this site, one of the things we looked at was the impact of their facilities. I’d like to share some of the impact numbers from the 2016 annual report from their flagship LabCentral facility, which opened a little more than three years ago in Kendall Square near Boston.

- They have 25 resident companies, and 24 companies have graduated from their incubator. These 49 companies have raised a total of $1.1B in funding.
- 717 jobs have been created by LabCentral companies since it opened.
- 73% of the resident companies were founded or cofounded by immigrants.
- 93% of the graduating companies have stayed within 4 miles of LabCentral.
- And, of course, they have been developing lifesaving medicines and creating breakthroughs in medical science.

Another thing that is relevant to this discussion is that LabCentral was founded with a $5 million initial investment from the Commonwealth of Massachusetts in 2013. Massachusetts invested an additional $5 million for the expansion of the LabCentral facility. So, a relatively small investment by Massachusetts into an incubator focused on leading edge technologies and teams, and then the creation of strong support programming for those teams, has had an outsized impact on the creation of life science innovation in the Boston area. We hope and expect that Princeton’s investment will have a similar impact. And we encourage the State to consider making moderate investments in incubators and accelerators in New Jersey, and in organizations that work to coordinate efforts among the many incubators in the State.

Also, while Princeton has made an investment in the local ecosystem, we encourage the State to, at the very least, maintain the incentive programs that are administered by the EDA to help support these small companies. This includes programs such as the Angel Investor Tax Credit, the Founders & Funders program, the NOL program and the Edison Innovation Fund.

At the same time as Princeton was creating the Princeton Entrepreneurship Council, it also made another critical addition to the staff in the Office of Technology Licensing. Princeton made a strategic decision to create a new role focused on spinouts, and hired
a New Ventures Associate. My colleague Tony Williams works directly with faculty and graduate students interested in starting companies. Along with his colleagues in OTL, Tony worked to launch ten companies based on University intellectual property this past year. This is considerably more than Princeton has spun out in past years.

The technologies being spun out of Princeton are of an excellent quality -- but, generally, academic spinouts are very early stage, and Princeton is no exception. Academic startups are often in the 'Valley of Death' funding stage that many venture funds won't touch. Princeton’s Office of Technology Licensing has had to work with faculty inventors to find other ways to get the University spinouts through that Valley. They have cultivated relationships with some of the few genuinely patient capital investors. Or they have found that the faculty member, or a co-founder, has had their own capital connections, or has joined an accelerator – which has typically meant that the startup has left NJ.

We think that there are two specific ways that the state can help to support academic spinouts. The creation of a seed fund, which invests in technology in the ‘Valley of Death’, could be one way that the state could support promising technologies being spun out of New Jersey’s academic centers. This would bridge the gap to more traditional venture funding for these startups.

And, another way the state can support academic spinouts is to help us to attract experienced business entrepreneurs who can mentor or partner with our scientific entrepreneurs. Our strong scientific founders, coupled with strong business founders, create teams which are appealing to investors and are poised for successful implementation.

Princeton University, as does the state of New Jersey, faces challenges in creating a welcoming environment for entrepreneurs. We could benefit from an approach that integrates business incentives with infrastructure investment in transportation and other resources to make New Jersey an economically feasible and attractive
option. Today's millennials are seeking vibrant communities in which to live and work, ones that are affordable and accessible by public transportation.

Turning now to the topic of Princeton's collaborations with industry... Earlier in my testimony, I mentioned Princeton's unofficial motto. This motto defines and bounds our efforts to engage with industry on research as well. As a recent Princeton Provost expressed it,

"Research is one of the ways that Princeton works to fulfill its informal motto, 'In the nation's service and the service of humanity.' We celebrate the benefit to humanity that starts with the creation of knowledge, and continues with the transfer of that knowledge into life-saving and life-improving technologies... We at Princeton, with the help of the business and technology-transfer communities, have a tremendous opportunity to make a profound and lasting beneficial impact on the world."

At Princeton, collaborations help transform theories and research that begin in classrooms and laboratories into real-world projects that can make a difference to society. As President Eisgruber has said, "By talking to industry scientists, our faculty learn about the kinds of questions that matter in the world."

At Princeton, the Office of Corporate Engagement and Foundation Relations is located within the Office of the Dean for Research. CEFR offers a front-door to businesses, helping them to identify and build mutually beneficial research collaborations with all aspects of the University community. Princeton places importance on fostering strong, long-term relationships with companies that are not only financial, but are also centered around a collective effort.

Over the past few years, CEFR has undergone a similar evolution to the Entrepreneurship Council and the Office of Tech Licensing. Under director Coleen Burrus, who joined Princeton in 2015, the Office has ramped up its efforts to engage with NJ industry and organizations. Among the areas in which CEFR is focusing its efforts is Life Sciences. For example, the University has increased its participation and
leadership in such organizations as BioNJ, the HealthCare Institute of NJ, the NJ Tech Council, Choose NJ, and the Research and Development Council of NJ. Princeton now has a corporate engagement officer, Dean Edelman, whose full-time focus is building relationships with companies in the life sciences ecosystem.

In addition, Princeton's Dean for Research encourages faculty collaborations with industry through The Innovation Fund for Industrial Collaborations, a competitive grant program that provides University funding for projects that have industry support.

We also note that, over the past year, the Legislature and the Governor made significant strides to support, encourage and incentivize academic-industry collaborations. These included the creation of a Commission on Higher Education and Business Partnerships, to which President Eisgruber and several other college presidents and industry representatives were appointed.

State efforts also include an expansion in the GrowNJ tax credit program to include companies that partner with research universities AND locate within three miles of that institution. This geographic consideration will help us to build strong local ecosystems around strong academic communities.

And the Legislature and Governor also teamed up to provide new fellowship opportunities for PhD students and postdoctoral researchers working in information technology. The program provides for at least 20 fellowships, of 2-3 year durations, in New Jersey companies with projects that are technology and research based. It also includes set-asides for very small companies. While this program does not focus on biotechnology, it does provide an opportunity for biotech companies to participate, and may provide a good model for similar programs focused on other industries.

Undoubtedly as a result of many factors, Princeton is seeing an increase in the desire of life science companies to engage with the University and its faculty. Princeton has relationships with long-time New Jersey companies, such as Merck, BMS, Janssen, and
Celgene; and also with companies that have recently moved facilities to the state, including Daiichi Sankyo, Mallinckrodt, and Evotec.

Princeton’s collaboration with Merck is a good example of the long-term, multipoint engagement that the University believes best supports its education and research mission and the interests of its corporate collaborators. The Merck Center for Catalysis opened in 2006 with initial funding from the company; and in 2017 they announced additional funding for the Center. The Center for Catalysis is a state-of-the-art facility at Princeton featuring a robotic system that allows for rapid set-up, monitoring and characterization of thousands of reactions. In addition, Merck also supports faculty research in chemistry and in molecular biology. And the company engages with graduate students, postdocs and the broader University community through participation in programs such as our annual Celebrate Princeton Invention event, and in the Molecular Biology "Lunch & Learns," designed to help grad students understand career options in industry.

Merck’s engagement highlights another benefit of academic-industry collaborations relevant to life sciences companies. And that is the issue of feeding the talent pipeline. Academic-industry collaborations provide a way for graduate students to learn about industry careers and for companies to become familiar with our grad students. And we are seeing more graduate students who are interested in pursuing careers in industry and in spin-outs. **Policymakers may want to give thought to ways that encourage grad students to work with the local biotech industry, and to stay in NJ during the next phase of their careers.**

The last topic I would like to highlight today is collaboration among New Jersey’s higher education academic institutions. Princeton views its collaboration with the state’s other higher eds as an important part of its efforts to connect with and strengthen the NJ innovation ecosystem. There are two projects in particular we would like to draw your attention to because of their relevance to life sciences companies.
The first is the NJ Research Asset Database, a project being developed under the auspices of the NJ Secretary of Higher Education and the EDA, along with the participation of many of the state's innovation organizations. Princeton has taken a leadership role in facilitating the state's adoption and implementation of this new tool and is one of five institutions participating in the pilot program. The NJRAD will be a publicly available and searchable database that will allow researchers and industry to more easily determine the research interests of faculty at New Jersey's participating institutions. This improved transparency will make potential academic and industry collaborations easier to identify and form. **State funding of this project is vital.**

The second example of higher ed collaboration is lower tech. This past October, Princeton hosted a "Biomedical Data Science Day." The event brought together academic researchers from Princeton and Rutgers with industry peers from top pharma and biotech companies. The goal of the day was to share information on the latest advances in biomedical data science and to initiate a discussion, led that day by Bob Hugin, Executive Chairman of Celgene, about the potential of forming a community to advance our region's strength in genomics, machine learning, Artificial Intelligence and computational biology. The event was very well received. Noting how his own collaboration with a Princeton researcher had come about by chance, one Rutgers researcher remarked, "It shouldn't be serendipity and luck that brings academics together... We need to create models and structures and systems and individuals" that bring together researchers and companies with similar scientific interests. There is now interest in pursuing this initiative in a larger conversation with other academic institutions, including NJIT, and similar future events are being discussed.

These are just some of the many initiatives at Princeton that are happening at this potentially transformative moment. We look forward to continuing to work with our peer institutions, ecosystem advocates, like BioNJ, and interested parties from our state's government to foster entrepreneurship and mutually beneficial engagements that both advance Princeton's mission of research and teaching while also potentially leading to collaborations that foster life science breakthroughs which improve and save lives.
Testimony to NJ Biotechnology Taskforce
Thursday, January 25, 2018

Catalyzing the Growth of Biotechnology in New Jersey: The Case for Gap Funding

Dear Chairwoman Hart, Assemblyman Zwicker, Taskforce Members:

Thank you for inviting me to speak to the NJ Biotechnology Taskforce. I would like to start by explaining my background and my qualifications to provide testimony in this forum. My name is David Kimball, and I am the Vice President of Innovation and Research Commercialization at Rutgers University. In that capacity, I am responsible for shepherding faculty inventions from their inception through patenting, marketing, licensing and as appropriate, assisting in the creation of new spin-out companies based upon these technologies.

In addition to standard “tech transfer” activities, we have created under my direction two new capabilities at the university which directly impact our ability to advance biomedical discoveries towards commercialization. First, we have established a unique biomedical research core (“Rutgers Translational Sciences”) comprised of seasoned research staff who were previously employed in the pharmaceutical and biotechnology industries. These professional staff assist faculty in generating translational data – medicinal chemistry, molecular imaging, research pathology, histopathology and screening to dramatically increase the competitiveness of grant applications and faculty’s ability to generate robust intellectual property. In addition, the RTS group serves as an interface between the university and the private sector, and has provided experimental data for biopharma companies in the region, thereby supporting the biotechnology ecosystem.

Second, we have established a new fund with the specific objective of building value from Rutgers intellectual property and moving technologies towards commercialization. I will speak more about this in a moment.

My experience in biomedical research reaches back to my Ph.D. degree in chemical biology and synthetic organic chemistry. In 1982, I moved to New Jersey to work at the Squibb Institute for Medical Research, which was rapidly expanding following on their commercialization of the first rationally designed drug, captopril. I spent 19 years at BMS, leading research groups for 15 years. In the summer of 2001, I left BMS for an opportunity to build small molecule drug discovery at Lexicon Pharmaceuticals, a Texas-based biotech which located its small molecule chemistry specifically in New Jersey because of the talent pool that was available. Over the next 6 years, I built a chemistry team of 75 exceptional scientists including medicinal, analytical, process and computational chemistry, attracting the PhD and postdocs from Stanford, Caltech, Princeton and Columbia. As Lexicon transitioned into a company focused on clinical trials, I moved to Pharmacopeia, in Cranbury, NJ, where I was the Senior VP of Nonclinical Research. In that role I gained further direct experience and insight into drug development and manufacturing. In 2008, research at Pharmacopeia was discontinued and the company was later sold to Ligand Pharmaceuticals. At this juncture, I was unable to identify an attractive position in biomedicine in the State of New Jersey, and was recruited to Hydra Biosciences in Cambridge, MA as Chief Scientific Officer. The long commute to Cambridge gave me a great deal of time to reflect on the value of a robust biotechnology ecosystem. The energy in Cambridge reminded me of central New Jersey in the 1980s and 1990s, when my career was younger and big pharma was at its peak.

Unlike many of my New Jersey drug discovery colleagues, I would not move to Massachusetts. As soon as I identified a suitable opportunity at Rutgers to build biomedical research, I returned home. Finally, I am co-founder of Z53 Therapeutics, a biotech based on discoveries made at the Rutgers Cancer Institute of NJ. In short, I have both the direct experience and the motivation to provide testimony on our biotechnology ecosystem in New Jersey.
The Data:
Let's start with the data in the recent BioNJ White Paper of January 4th. Table 1 is taken from page 3 of the White Paper and shows the rankings of NJ relative to other states with biotech hubs, comparing a number of parameters that affect the region’s attractiveness for biotech. What is striking is the similarity between New Jersey and the states that are our most immediate competitors: MA, CA and NY. The quality and quantity of talent, infrastructure, overall business environment, industry environment and cost of doing business are broadly similar. Furthermore, NJ is as attractive as MA in PreK-12 education and as CA in the value of incentives offered to business. So, we cannot attribute our challenges in growing a vibrant biotech industry to taxes or the local business environment.
New Jersey does clearly lag in the amount of NIH funding (#23 vs. #1,2,3 for CA, MA, NY). And while NJ ranks #23 in universities vs. #1, 11, 2 for CA, MA, NY, the location of the garden state, sandwiched between the significant biomedical research centers of New York City and Philadelphia, should be looked upon as an opportunity. Indeed, in the past, biotechnology companies spawned at Columbia and Mount Sinai led to NJ-based companies (Pharmacopeia and Amicus, respectively).

The Challenge:
My thesis is that the decline of the NJ pharmaceutical industry and the anemic growth of biotechnology relative to MA and CA, can be attributed in part to two things that are under our control, and (2) a derivative of the evolution of pharma/biotech as a business: (1) lack of strategic focus and (2) a resulting dearth of financial support for the nascent biotechnologies to seed the NJ biotech industry. This is clearly illustrated in Figure 1, which shows that all of our peers have State and Federal programs to support gap funding; New Jersey alone is amongst the seven states without gap funding from either source. The seed funding of early biotech innovations is the foundation upon which the industry grows. Given compelling biotechnologies, biotech startups can be formed; given compelling biotech companies, venture capital and deals will flow in; given capital and research muscle, the Enzymes, Biogens and Genetechs of the 21st century will evolve.
Figure 2 captures a “valley of death” that is the first hurdle for nascent biotechnologies. Most often, these start as discoveries in the medical school or biology departments of faculty principal investigators (PIs), who may – or may not – have contemplated developing a product and commercializing their discovery. In order to approach this issue, the PI needs to generate sufficient funding to obtain “proof of concept”. While this gap is common to all technologies, it is especially acute in biotech, where the requisite studies can be costly and are generally not covered by available federal, state or foundation granting mechanisms. Critical proof of concept studies at this stage could include the synthesis of probe molecules to elucidate a biological pathway, the conception and reduction to practice of a small molecule or antibody that can be awarded a composition-of-matter patent, exploratory toxicology and pathology studies to de-risk the project, imaging, screening, metabolism and pharmacokinetics, and screening for off-target activities.

The Prototype:
Successfully obtaining these data can be sufficient to generate further funding in the form of NIH and SBIR grants, angel or seed investing. Rutgers’ strategy to address this need has been the recent creation of the TechAdvance™ Fund. This fund is specifically designed to bridge the gap between early discoveries and data or intellectual property that can lead towards commercialization. Applicants to TechAdvance™ are required to have filed a notice of invention with the tech transfer office and to have done market research with companies that are potentially interested in licensing, developing or otherwise supporting the technology. Critically, the decision whether to fund the application is driven by reviews from three independent industry experts. These grants provide faculty with up to $100,000, dependent
upon achieving defined and measurable milestones. Applicants may apply for a second tranche of $100,000 if the defined objectives are being met and the additional funds will drive increased value. This process maximizes the integrity and objectivity of decision-making. The fund was initiated with a pilot study at the beginning of 2017, and opened to all faculty in June, 2017. To date, over $900,000 has been awarded to research projects. One of the technologies supported by TechAdvance™ has already been licensed to a new local startup company (not biotech).

The Proposal:
As instrumental as it has been in catalyzing research aimed at commercialization, it is critical to note that Rutgers’ TechAdvance™ fund, by itself, is not sufficient to accelerate of the inventions at the university, not to mention the state-wide need. In order to effectively trigger the birth of new biotechnologies in New Jersey, there are three specific requirements:

1) The State of New Jersey needs to create a seed funding mechanism that is similar in function, if not form, to the TechAdvance™ fund. To strategically catalyze the nascent biomedical technologies across the State would require an allocation $10M per year.

2) This funding mechanism must be run and evaluated independently of New Jersey’s major academic research institutions and must serve scientists and entrepreneurs across the State. In order to effectively administer such a proposed gap fund, the Commission on Science and Technology should be (re)formed. Additional supportive activities of the Commission would be post-doctoral support for new spinouts and bridge funding of SBIR grants that are in between Phase 1 and Phase 2, as had been provided by the historical Commission.

3) These actions should generate a flow of biotechnology opportunities across the State of NJ that could attract funding, startup formation and licensing from larger biotech and pharma. New Jersey has several pockets of talent distributed across the State, most obviously along the Route 1 corridor from Newark → New Brunswick → Princeton → Camden. Each of these loci is surrounded by a distinct ecosystem with unique opportunities for biotechnology. It is critical for us to recognize that our strength does not lie in a single locus, e.g., in Cambridge, MA, but that we must meet the challenge of creating a plan to build our biotechnology capabilities in a more distributed manner. Otherwise, our centers of excellence will end up fighting a sum-zero game for the limited resources and not compete effectively with our aspirational peers.
Table 1: State Rankings on Metrics Important to Businesses*

<table>
<thead>
<tr>
<th>Category</th>
<th>Metrics</th>
<th>NJ</th>
<th>CA</th>
<th>MD</th>
<th>MA</th>
<th>NY</th>
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<td>Quality and quantity of talent</td>
<td>Educational attainment of population</td>
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<td>3</td>
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<td>7</td>
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<td></td>
<td>No. of universities</td>
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<td>30</td>
<td>11</td>
<td>2</td>
<td>8</td>
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<td>Quality of life</td>
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<td>48</td>
<td>22</td>
<td>1</td>
<td>34</td>
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<td>Cost of living</td>
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<td>48</td>
<td>46</td>
<td>49</td>
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<td>Quality of roads</td>
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<td>44</td>
<td>34</td>
<td>15</td>
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<td>Overall business environment</td>
<td>Overall GDP</td>
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<td>15</td>
<td>11</td>
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<td>Cost of business</td>
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*BioNJ White Paper January 4, 2018

Figure 1: Support for University Gap Funding

Does Your State Support University Proof of Concept and Startup Gap Funding?

2017 Innovosource, Mind the Gap
Figure 2: The Funding Gap and the Valley of Death

*Government funding typically tapers off before the private market is ready to step in and fund early stage technologies.
1. Please detail what programs or support is offered by your institution that is helping to successfully create spin-offs?

- NJIT’s Enterprise Development Center (EDC) opened in 1989 is the state’s oldest and largest technology business incubator with 95 companies, that generate $145.0 million in total economic output for the state, support roughly 1000 jobs and create $3.4 million in tax revenues for New Jersey. The business initiation and growth services result in a 5-year post-graduation persistence rate of over 85%.

- NJII’s Health IT Connections program that guided over 100 companies in the last three years to achieve 46% annual revenue growth and over 40% annual employee growth as a result of the cluster building activities.

- NJIT’s recent investment of $40M to create the Integrated Life Science & Engineering Center and the NJIT MakerSpace offer access to advanced analytic and fabrication equipment & services

- NJII has launched a new Cell & Gene Therapy Manufacturing Center (Nutley) and partnered with Rutgers to create a new Continuous Pharmaceutical Manufacturing Center (New Brunswick) offering workforce training, process development and small scale manufacturing services to industry.

- NJII is launching a new Innovation as a Service model that includes curating tech-specific clusters of small companies and connecting them to OEMs in joint problem solving.
2. Are there any gaps or challenges that could be addressed by the State of New Jersey that would further empower your institution to create more spin-offs?

- NJ ranked 50th (last) in recent Beacon Hill Institute State Competitiveness Ranking for Business Incubation
- There has been no state support for university run incubators since the NJCS&T was shuttered
- The base costs of running an incubator exceed space rentals at full occupancy at market rates. Universities need to subsidize against tuition revenues – or close.
- The EDC property is taxed as a commercial property by the City of Newark – roughly $500,000/yr.
- University Commercialization Offices are not Self-sustaining
3. Is there any current collaboration between your institution and industry within the state and, if so, how has that been beneficial?

- NJII is a new model for university-industry-government collaboration leading to business formation and growth. It has added nearly $40M in new R&D revenues to the university – 40% growth in 4 years – based on industry sponsored or industry directed programs.
- NJII has linked the university to new corporate partners and greatly expanded the relationship with others that had supported NJIT.
- NJII programs and EDC companies have created career linked work experiences for 400 students per year.
- NJII projects engage faculty in projects that lead to Use Inspired R&D
4. What steps can the State of New Jersey take to facilitate greater collaboration between academia and industry?

- Create a framework to Fund Incubation Facilities & Programs
- Ensure Statewide Coordination of Programs & Assets
- Develop place-based, cluster approaches
- Re-establish SBIR & Grant match programs
- Provide Tax Relief to Municipalites hosting Non-profit Incubators
Testimony of Kenny Wong, Ph.D.
Teaching Associate Professor and Biology Program Director
Department of Chemistry and Chemical Biology
Stevens Institute of Technology
New Jersey Biotechnology Task Force Meeting
January 25, 2018

Thank you for giving the Stevens Institute of Technology an opportunity to offer our views on how to build a first-rate innovation economy in the State of New Jersey. Innovation and entrepreneurship are intrinsic to Stevens’ educational and research mission. Stevens is a private nonprofit science and technology-focused educational institution with a rich history of educational excellence and research innovation. We aspire to ensure that every Stevens graduate has the mindset and skill set to be innovators and entrepreneurs when they enter the workforce—and some, even before they graduate.

Stevens Institute of Technology was founded in 1870 by America’s First Family of Inventors, the Stevens Family. This was a family of innovators who patented steam ferries as well as the modern form of railroad track, amongst other inventions. Located in Hoboken, Stevens is home to 6,600 undergraduate and graduate students who collaborate with approximately 300 faculty members in an interdisciplinary, student-centric, entrepreneurial environment. Within the university’s three schools and one college, Stevens offers a range of academic and research programming including business, computer science, engineering, the arts and other fields which actively advance the frontiers of knowledge while leveraging technology to confront our most pressing global challenges.

Stevens Institute of Technology is home to three national research centers of excellence as well as interdisciplinary research programs in fields such as artificial intelligence and cybersecurity, data science and information systems, complex systems and networks, financial systems and technologies, biomedical engineering, healthcare and life sciences, as well as resilience and sustainability. Innovation and entrepreneurship are intrinsic to Stevens’ educational and research mission.

Since 2011, U.S. News & World Report rankings of higher education institutions have recognized Stevens as one of the nation’s top universities including a recent ranking of #69 in the category of Best National Universities as well as being named one of the Top 25 “Most Innovative Schools” in the nation for 2018. Stevens Institute of Technology was recently cited by Forbes Magazine as “one of the most desirable STEM colleges in the nation.” As the fourth largest employer in the City of Hoboken, Stevens generates $269 million in economic output to the State of New Jersey.

In order to initiate discussion of the Task Force’s first question regarding programs offered by Stevens to create spin-offs, I am proud to tell you about the work of the Stevens Office of Innovation and Entrepreneurship (OIE), which coordinates, facilitates and manages the university’s entrepreneurial and technology commercialization programs and activities. OIE is a
one-stop shop for faculty, researchers, undergraduate and graduate students and alumni looking to start a company or in need of assistance in identifying market opportunities. The Office assists with business strategies, tailoring and field-testing solutions, sourcing marketing teams and capital, and bringing real-world corporate and entrepreneurial experiences back into the undergraduate and graduate curriculum. OIE hosts and supports regional, national and international events which promote entrepreneurial activities including the New Jersey Tech Meetup, the Propelify Innovation Festival as well as the periodic meetings of the International Council for Small Business.

The Stevens Office of Innovation and Entrepreneurship also manages the day-to-day operations of the Stevens Venture Center, an incubation program dedicated to the development of student and faculty start-up companies. SVC is an innovative entrepreneurship ecosystem designed to connect Stevens entrepreneurs with an infrastructure, resources and funding assistance with the objective of building an ecosystem of entrepreneurship on campus, leading to sustainable and successful commercial entities based on Stevens-derived technologies. SVC's mission has two goals: educating our students in modern entrepreneurial thinking and providing the opportunity for students and faculty to explore the commercialization of their ideas. We encourage ingenuity in research and promote initiatives for change in education, infrastructure and administration.

With regard to gaps or challenges that could be addressed by the State that would further empower Stevens to create more spin-offs, the State should re-establish—in some form—the efforts of the former New Jersey Commission on Science and Technology. Between 1985 and 2010, the Commission on Science and Technology generated innovation and economic growth, which is well documented in the State. During this period, grant funding was awarded to vibrant scientists and engineers in partnership with colleges and universities in the State to carry out cutting-edge research or launch new businesses. The work of the Commission on Science and Technology advanced life-changing technologies and spurred new knowledge, innovation and creativity in fields such as biomedical engineering, renewable energy and telecommunications.

In its final year of operation, the Commission on Science and Technology awarded 30 grants to Technology Business incubators and early-stage technology companies which leveraged $3,482,208 in private and federal funds from Commission grants of $2,521,740. These grant awards accounted for the creation or retention of over 2,000 high-paying science and technology jobs in the State. Projects funded in 2009 alone supported innovation in the fields of dental bone grafts, cardiac monitoring, drug discovery and delivery, as well as precision timing synchronization. Unfortunately, due to budget restrictions, the New Jersey Commission on Science and Technology was defunded with the passage of the Fiscal Year 2010 State Budget.

The State would also benefit from providing annual funding in the form of 2-year investigator-initiated research grants to academia or industry to generate discoveries and intellectual property that will seed the formation of new and/or strengthen the portfolio of existing companies in our State. At the same time, New Jersey would benefit from advancing the establishment of innovation centers of excellence in academia that will catalyze academic and
industrial research within the State of New Jersey by providing expertise, personnel and technical infrastructure that can be leveraged by academic researchers and small companies. This will help the latter to develop their technologies and services in a cost effective manner without having to make large investments in infrastructure.

These 2-year investigator-initiated grants would support new STEM ideas toward proof of concepts (POC) that will generate IP and technologies for seeding new start-ups. Creating new start-ups will enable the State of New Jersey to capture graduates from universities through employment opportunities and counteract the brain drain effects as big companies reorganize toward building R&D organizations in areas such as Boston and San Francisco. The establishment of new innovative centers of excellence that academic institutions and industry can access to catalyze their research and serve as a scientific hub to foster collaborations will have the potential to go beyond state boundaries and impact research in neighboring states such as the growing biotech ecosystem in New York City. Some examples include new technology platforms in the area of genetics, computational biology, bio-printing to just name a few, will enable academic and small industrial labs of all sizes in the state to accelerate their R&D enterprises toward commercializing innovative science.

Many of the concepts addressed are embodied in legislation currently pending before the Legislature, A-1930, which would establish the Edison Innovation Science and Technology Fund in EDA. If enacted, this legislation would provide funding for individual investigator-initiated grants for proof of concepts that will lead to innovative discoveries. This program would also provide funding for academic collaborative groups engaged with an industrial partner that will enable their research toward commercialization. This legislation would spur collaboration between academia and industry while also seeding a new momentum in rebuilding a first-rate innovation economy in the State of Jersey.

Stevens supports BioNJ’s recommendation for increased funding for incubators in New Jersey. BioNJ’s recent report, The New Jersey Biopharma Industry: A Prescription for Growth reported that California has more than doubled the number of biopharma incubators in the State. As reference in the report, “996 biopharma companies were founded in California between 2011 and 2015, and another 296 were founded in 2016.” Incubators are a proven economic development tool designed to accelerate growth and success of entrepreneurial companies. New Jersey would benefit from increased funding as we seek to flourish in the innovation economy.

Stevens has had great success in collaborative efforts with industry in the State. As an example, Stevens is home to the Center for Healthcare Innovation (CHI) which works to advance medical technology and improve healthcare delivery through education, research and partnerships which connect the fields of biology, engineering and computer science. CHI also works to strengthen the healthcare workforce by identifying skill gaps and adapting or creating curricula designed to address these gaps.
Within the Center for Healthcare Innovation, Stevens has developed the Biotechnology and Drug Discovery Laboratory, which is a research and training facility established in part from a generous donation of equipment and supplies from Roche and Merck with also the support of the New Jersey Department of Labor. The laboratory’s mission is to facilitate partnerships by Stevens faculty and students with external academic and industry collaborators who require the expertise of the laboratory to advance their research.

The Biotechnology and Drug Discovery Laboratory is operated by 11 scientists, all formerly employed at Roche, Merck and Novartis, with extensive experience in biotechnology and drug discovery, five of which have over 150 years of combined R&D experience in pharmaceutical and biotechnology corporate laboratories. Since its inception, the Biotechnology and Drug Discovery has established numerous collaborations across New Jersey which have proven beneficial in the biotechnology/pharmaceutical sector. Examples include moving our discoveries into the clinic through a long standing translational research partnership with Hackensack University Medical Center, New Jersey’s top rated and largest hospital and a new educational partnership with the new Seton Hall Hackensack Meridian School of Medicine. Further, contractual relationship with Cepter Biopartners, a NJ-based contract research organization, provides us with drug discovery and development projects from biotechnology and pharmaceutical companies. Our students have benefited from the professional experience through these industry collaborations on campus; in addition, internal projects initiated from Stevens faculty have yielded new drug patent applications and the emergence of spinoff companies.

With regard to the Task Force’s final question, we strongly support the establishment of the Edison Innovation Science and Technology Fund which was previously noted is an ideal program to strengthen industry-university research collaborations while also creating the increased potential for attracting federal funding and private investment.

Thank you for the opportunity to speak with you today. I welcome any questions that you may have.
Testimony to New Jersey Biotechnology Task Force

Introduction

- For those of you who don’t know me, my name is Bradley Campbell and I’m the President and Chief Operating Officer of Amicus Therapeutics. I’m also a member of the Board of Directors of BioNJ and I have lived in Hopewell New Jersey for the past 12 years with my wife and family.

- Let me start by thanking the Economic Development Authority and the New Jersey Biotechnology Task Force for inviting us all to speak here today. This is a great example of a bi-partisan, public/private initiative to focus on making our biotech community here in New Jersey great. Also let me apologize in advance as I have to get back to the office for a previous commitment and will not be able to stay much past the Q&A session.

Amicus Mission and Vision

- At Amicus, our dual MISSION is clear: we seek to develop the highest quality therapies for people living with rare metabolic diseases and thereby maximize value for our shareholders. Today there are more than 300 patients globally who are treated with an Amicus medicine. And at the JPMorgan conference, THE largest healthcare industry conference of the year which took place in San Francisco two weeks ago, we announced for the first time our VISION, that by 2023, just five years from now, we hope to treat 5,000 people with an Amicus medicine, which is very significant in the rare disease space and could generate more than $1B in revenue and put us in the same league as other great companies in this space like BioMarin and Vertex.
**Amicus Strategy**

- Our strategy is to create, manufacture, test and deliver great medicines for orphan diseases. We’ve invested in core technologies which are the basis of our approved medicine and product pipeline, and we seek to advance and expand this pipeline with potential first-in-class or best-in-class drug candidates. Our biologics capabilities as well as our global infrastructure allow us to deliver medicines to patients today and provide a platform for future opportunities. We are in a period of significant growth as we continue to build a leading GLOBAL rare disease biotech company.

**Strategic Goals:**

Create...

Manufacture...

Test...

Deliver...

...Great Medicines

**Critical Initiatives:**

- Invest in core internal scientific technologies
- Actively in-license complementary products and technologies in rare metabolic diseases
- Strengthen and expand relationships with WuXi Biologics and other core manufacturing partners
- Build internal capabilities and capacity for biologics manufacturing
- Complete build-out of global commercial and development footprint with world-class teams
- Apply highest levels of business ethics and social responsibility

**Additional Amicus Metrics**

- Let me share some additional corporate metrics:
  - Public company listed on the NASDAQ with market cap over $2.5B
  - Employees: ~400 global full time employees and contractors, including 280 at our headquarters in Cranbury NJ and we expect to grow to almost 600 by year end.
  - Revenue: ~$36M in FY17, all from our precision medicine, Galafold, for Fabry disease, which is approved in Europe and many other jurisdictions outside the U.S. and was submitted to the US FDA in December
  - Cash: strong balance sheet with ~$359M in cash as of 12/31/17 to fund our current operating plan into the second half of 2019
NJ Bio Task Force Outline

- Global footprint: Amicus has employees or consultants on the ground in 27 countries, including offices in 8 international countries
- Finally, we have a robust pipeline including a biologic in development for Pompe disease, which demonstrated incredibly exciting Phase 2 data in patients last year and which we’re currently manufacturing with WuXi Biologics

Amicus History with New Jersey

- Amicus has had a very rich history with New Jersey and the ecosystem here.
- Amicus is truly a home grown New Jersey Company. Our very first headquarters was right here at the CCIT thanks to generous support from the EDA and in 2005 we became CCIT’s first graduate when we moved to our current facilities in Cranbury.
- We’ve been an active participant and contributor in the great programming and leadership of organizations like BioNJ and HINJ and have certainly benefited from the broader biotech and pharma ecosystem here which is clearly a strength of our state.
- And while 99% of our funding has come through our investors and our strategic partners, we’ve also benefited from the State’s net operating loss program, and we have taken advantage of a number of sponsored workforce training programs over the years
- Thanks in part to the ecosystem here in addition to the hard work and persistent dedication to our mission, we’re now one of the top pure play biotechnology companies in New Jersey.
Two Major Strategic Initiatives

- We have two major strategic initiatives underway that are very germane to our discussion here today.
- First, as I mentioned, we’re growing rapidly. We’ve now run out of space at our current Cranbury facility, so we need to determine where to locate our new Global headquarters. We project the new facility will require over 200 thousand square feet of office space and accommodate our employee growth in New Jersey for many years to come.
- Second, with the advances in our Pompe program, we’ve decided to invest in our own state-of-the-art biologics manufacturing facility which we estimate to be a $150-$200 million dollar plant to support over 200 highly skilled employees in a 200 – 300 thousand square foot facility, AND that we may expand significantly to co-locate with an R&D hub.

New Jersey BioPharma Industry: A Prescription for Growth

- As we continue our diligence on where to locate these facilities, one resource we’ve used is the great report "The NJ Biopharma Industry: A Prescription for Growth" that BioNJ published earlier this month on the Biopharma industry in New Jersey. I’m sure many of you are familiar but let me highlight a few important statistics:

- First the positives:
  - Biotech represents 3.7% of New Jersey’s gross domestic product vs 1.9% US
  - 350 thousand direct, indirect and induced jobs
  - <$20/sq ft for lab space (vs $50 in San Fran and $70 in Boston)
  - 2300 patents filed and 25K publications from NJ/NY cluster
  - Nearly 1/3 of drugs approved by FDA from 2015 to 2017 are from companies w/ HQ in NJ
NJ Bio Task Force Outline

- But as noted in the same BIO NJ report, there are some significant challenges facing our state and our industry. I believe that these are truly threatening our sector and our preeminence in biopharma.
  - We are the 23rd State in the Country for number of universities for healthcare and biotech
  - 23rd in NIH funding and 46th in regulatory environment
  - And ranking at 41 in the country for cost of living, New Jersey is increasingly unaffordable for our families to live in, which is potentially made worse by the changes to the Federal tax laws that may disproportionately impact our State.
  - Most importantly for cost of business: Labor and Utilities costs are 40th in the country, Property costs are 44th
  - All this has led to significant negative impact on BioPharma Employment growth which has shrunk by 2.2% from 2006-2016 vs states like CA and MA which have grown by >2%. And specifically from 2005-2015, BioManufacturing has shrunk 3.6%, again when many rival states have grown including MA, CA and NC

**Impact on Amicus**

- As it relates to our Global HQ, our home is in New Jersey. Our history is here, and we would love to keep our headquarters here, but some of these factors are forcing us to consider neighboring states because we need to choose a location that is sustainable for Amicus and sustainable for our families in the long term.
- As relates to our Manufacturing facility, for many of the reasons I’ve just discussed, the pressure is even greater to evaluate locations in other states that have compelling biotech and bio-manufacturing ecosystems coupled with strong and sustainable environments for growth and for attracting and retaining our workforce.
- We are very pleased that Governor Murphy and his new administration have also identified a number of similar issues facing our industry as high priority, and we are pleased they already have initiated a dialogue with us on how we can work together on these critical strategic initiatives.
NJ Bio Task Force Outline

**Proposals for the Committee**

- Let me close with a few proposals to this committee.

- First, I would look to BioNJ’s recommendations on fixing the critical environmental issues in our state in order to continue to attract and retain both the biopharma companies as well as the workforce to serve at those companies. Address the business environment and the quality of life issues, promote investment in life sciences innovation, make NJ the world leader in biopharma education and training, and strengthen our State’s biotechnology brand....bolster our story...and then tell it far and wide.

- I would also encourage members of this committee, our state, city and local governments to continue the bi-partisan work with companies like Amicus to ensure that we’re doing everything we can to keep the great companies we have and attract more just like it... and to keep the great people working at those companies living right here in New Jersey. We very much look forward to continuing to work with the Governor and his team on doing just that.

**Thank you and Q&A**

- That concludes my prepared remarks. Let me thank you again for your time and I’ll open up to Q&A.
New Jersey Biotechnology Task Force
-Testimony from Industry

January 26th, 2018

K. Stephen Suh

Genomics and Biomarkers Program
Hackensack University Medical Center
Hackensack Meridian Health
Goal: -Boosting Biotechnology Sector in NJ-

How: Provide excellent patient samples and data

- Enhance current structure of Biobank
- Set up infrastructure to access non-PHI patient data
- Bring doctors, researchers and scientists together

Why?:

Future demands Personalized/ Precision Medicine

How do you know?:

National and Congress data shows
How much money and time needed to make a drug?

Biomarker discovery (target identification and validation) is associated with high cost and time

**Cost (Avg 2 billion)**

Percentage of total R&D cost spent in each phase

![Cost graph]

- Target: 20%
- Target Compound: 20%
- Lead: 10%
- Preclinical: 10%
- Phase I: 10%
- Phase II: 10%
- Phase III: 10%
- identif., validations, screen., optim., studies: 10%

**Time (Avg 10yr)**

Percentage of total R&D time spent in each phase

![Time graph]

- Target: 20%
- Target Compound: 20%
- Lead: 10%
- Preclinical: 10%
- Phase I: 10%
- Phase II: 10%
- Phase III: 10%
- identif., validations, screen., optim., studies: 10%

Source: Life Science Insights, Ernst & Young, Tufts CSDD and Boston Consulting Group
Much of drug target discovery efforts ("-Omics") are happens on a research lab bench—this will not change.

Medical Centers → Clinical Samples

Physician’s role: “Procurement”

Biomarker (molecular target)

40% Cost of R&D

Samples land on lab bench
>100 personnel and multiple departments are involved in the pipeline of BioBank tissue procurement workflow

In-/Out-Patient Clinic

Phlebotomy/Clinical Lab

Surgical Procedure Rooms

Pathology Department

Physicians Nurses (Research, Education and Charge)

Schedulers, data coordinators Pre-/Admission staff/lab staff

Tissue Bank

(Clinical and Scientific Staff)

Courier/IT Dept/Telecom Dept
Doctors, Researchers, Patients & Payor
Accurate clinical and scientific data for everyone

Collaboration with Sophics Alliance, Inc and HackensackUMC: Biobanking/EMR
**Hackensack University Medical Center** (near 130 yrs old)

Hackensack Meridian Health/JFK

(21 Hospitals/Clinics/Hospice/Emergency - 6M patients/yr)

1. Ranks best in NJ and top 50 hospitals in US (out of 5500)
   a. 800 bed (Main campus), near 1500 doctors
   b. JT Cancer Centers
      * Ranks 5th in US for patient visit volume
      ** Top 10 cancer drug buyer
         (i) Approximately 1300 clinical trials active per year
         (ii) 15 Oncology Divisions (about 8000 newly diagnosed/yr)
         (iii) Out of 45,000/yr (HUMC alone) surgical procedures, about ½ is cancer related .. **Less than 1% comes to the BIOBANK**
Science advances are directly related to economic status

Effects of the Fiscal Policies in CBO's Long-Term Budget Scenarios on Real GNP per Person, Calendar Years 2010 to 2037

(2010 dollars)

- US economic capacity is shrinking and US budget in a shake-up mode:
  Such economic situation limits science

Source: Congressional Budget Office.

10-Year Treasury Rates and Historical Economist Forecasts
Percent

CBO
The Budget and Economic Outlook: 2014 to 2024

Note: Forecasts are those reported by Blue Chip Economic Indicators released in March of the given calendar year, the median of over 50 private-sector economists. Source: Blue Chip Economic Indicators, Aspen Publishers.
US must reduce and eliminate DEBT PROGRESSIVELY

Federal Debt Held by the Public Under CBO's Long-Term Budget Scenarios Through 2087

(Percentage of gross domestic product)

Source: Congressional Budget Office.

Projections of U.S. Public Debt Continue to Accelerate


Data Note: Figures represent CBO alternative scenario projections of debt held by the public.

Produced by Veronica de Rugy, Mercatus Center at George Mason University.

U.S. National Debt from 1940 to Present

US will cut spending and HEALTHCARE side is one of target

> 21% spending on Medicare and Medicaid side

+5% from Welfare
US HEALTHCARE side spends about 25% GDP
.... Increasing $cost

US (and the whole world) desperately needs innovative BIOTECHNOLOGIES and personalized and precision patient care that is...

* "Low $COST and ** ACCURATE

INDUSTRY ANALYSIS
U.S. Healthcare Industry

$3.09 USD TRILLION
U.S. Healthcare Industry Expenditure

25 The U.S. spends more than 17% of its GDP on health care (2014), which is estimated to grow to about 25% by 2020.

$2.24 USD TRILLION
U.S. Healthcare Industry Market Size

US HEALTHCARE now is on “40%” overdrive mode
US healthcare cost model is extremely ‘abnormal’.
This ‘abnormal’ healthcare model is “unsustainable”.
Running Out
Trust-fund balances as a percentage of expenditures at the beginning of each year

Sources: Social Security and Medicare Boards of Trustees reports

THE WALL STREET JOURNAL

‘No Money to Spend’ by 2030, unless we create innovative and highly efficient biotechnology model to support medicine and patient care

Figure 1.3.
Projected Spending in Major Budget Categories
(Percentage of gross domestic product)

Source: Congressional Budget Office.

a. Includes Medicare (not of receipts from premiums), Medicaid, the Children's Health Insurance Program, and subsidies offered through new health insurance exchanges and related spending.
b. Other than mandatory spending for major health care programs and Social Security.
Need Innovative biotechnologies, medicine & patient care models to **REDUCE $COST**

1. Prevention Medicine (**Population Selection** and detect disease early)

2. Personalized & Precision Medicine (**Patient Selection** and delivering ‘accurate treatment’ and low $cost drug

---

**Figure 4. Historical Growth Trajectory of National Health Expenditures, 1970-2011**

- National health expenditures as % of gross domestic product
- Annual growth rate of national health expenditures (adjusted for inflation)

---

Inflation adjusted
• 15% hospitalization is preventable (about $4 trillion out of $25 trillion total healthcare expenditure)

• 70% of $4 trillion expenditure is by Medicare patients

* >2/3 of hospitals on East Coast = More Collaboration Opportunities.

** >85% patients visit community hospitals in US = Gov + Academic + Industry must participate on R&D projects

Figure 1. Medicare patients contributed to 67 percent of total hospital costs for potentially preventable hospitalizations—significantly higher than the 50 percent share of costs for all other hospitalizations, 2006*
Root-based R&D Collaborations Needed

1. **Biobank**: Statewide infrastructure
2. **Data**: Access on clinical data without PHI
3. **Resource**: Provide high quality patient samples and data to biotechnology companies and academic/gov laboratories
4. **Environment**: Productive collaboration between doctors, researchers and scientists
5. **Education**: Teach students based on ‘on-demand’ courses to supply top quality and prepared work force to the biotechnology sector
6. **Grant**: Bench to bedside grants to bring destructive technologies and innovation
The New Jersey Biopharma Industry: A Prescription for Growth
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The New Jersey biopharma industry: A prescription for growth

EXECUTIVE SUMMARY

New Jersey has long been a critical economic engine for the United States, and the biopharmaceutical industry has been an important source of the state's growth for generations. A few key facts highlight its importance in the state: New Jersey is one of the top 10 innovation hubs in the world. It employs over 120,000 highly educated life sciences workers (of which 65,000 are biopharma). It is the operating base for over 1,000 biopharma companies, with more than 1,000 drugs in development by those companies. In 2015-2017 alone, New Jersey-headquartered biopharma companies accounted for 29% of the drugs approved by the FDA.

That said, the performance of the biopharma industry overall indicates New Jersey could be doing even better. Between 1995 and 2015, the U.S. biopharma industry grew approximately 2.3% CAGR, while New Jersey's sector grew only about 1.4%. This indicates substantial opportunities for long-term growth under the right conditions.

One of the chief reasons for the U.S. growth spurt is the substantial rise in the number of early-stage start-up companies. From 2012 to 2015, California saw 10 times as many companies founded as New Jersey, and Massachusetts four times as many. It may not be coincidental that New Jersey also received less federal and venture capital funding and has fewer academic-public sector research partnerships than peer states. At the same time, higher costs have made businesses reluctant to locate their operations in New Jersey.

Other states have successfully attracted biopharma companies through a mix of public, private, and non-profit levers, including targeted investment. Often thematic in execution, these investments focus on biopharma and on job creation, rather than job preservation, thereby generating a higher return on investment.

In this context, this white paper examines the health of New Jersey's biopharma industry, drawing on economic analyses, discussions with stakeholders from across the New Jersey biopharma ecosystem, and case examples of other centers of activity in the industry. The goals of the paper are to create transparency around New Jersey's strengths and opportunities, and lay out pragmatic recommendations to promote economic growth across the state through the biopharma industry. This research is informed by McKinsey analysis on biopharma in New Jersey, as well as a

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1 PitchBook, US Census Bureau County Business Patterns
recent McKinsey report (*Reseeding the Garden State’s economic growth: A vision for New Jersey*) that examined New Jersey’s overall economy.

Given these learnings and New Jersey’s context, this paper puts forth recommendations along four levers:

1. **Direct State government support** of the industry, including targeted financial incentives, tax credits, and funding private-public and academic-commercial partnerships

2. **Promotion of life science innovation and investment** in the state, including creating a new “BioPharma Super Cluster” as a hub of life science activity, most likely in North-Central NJ.

3. **Making NJ the world leader in post-graduate and mid-career Biopharma educational and training programs** that focus on retraining for manufacturing and R&D jobs that will be critical for the next decade, and are in critical short supply (e.g., advanced drug analytics; translational research; commercialization)

4. **Strengthening New Jersey’s brand**, including increased promotion and marketing of the advantages of founding or moving a company to the state.

Developing an environment for growth is crucial for improving New Jersey’s economic health. The state’s biopharma industry should be central to that strategy and New Jersey should build on its proven ability to ignite short-term growth and plant the seeds for long-term development.

**INTRODUCTION**

The state of New Jersey has played a key role in the U.S. economy since the nation’s birth. Today, the Garden State ranks as the 11th in population, with approximately 9 million people. Moreover, it is the 8th largest economy in the country, with GDP exceeding $500 billion and 22 Fortune 500 companies headquartered here.

Recently, however, New Jersey’s economy has grown more slowly than the U.S. economy as a whole. Between 2006 and 2015, the state’s growth rate averaged 0.2% per year, whereas the U.S. growth averaged 1.3%.

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2 US Census American Community Survey  
3 Bureau of Economic Analysis, Bureau of Labor Statistics, Moody’s Analytics  
4 Capital IQ  
5 Bureau of Economic Analysis, Bureau of Labor Statistics, Moody’s Analytics
EXHIBIT 1: STATE RANKINGS ON METRICS IMPORTANT TO BUSINESSES

<table>
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<th>Category</th>
<th>Metrics</th>
<th>State ranking</th>
<th>NJ</th>
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<td>Quality and quantity of talent</td>
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<td>Value of incentives offered</td>
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<td>37</td>
<td>50</td>
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</table>

One reason for this under-par performance is the current condition of New Jersey's life sciences industry relative to its history and relative to other states. Known as “the medicine chest of the world,” the state has been a major global hub for biopharma for more than a century. Yet in recent years, New Jersey's biopharma industry has not kept up with other states, particularly California and Massachusetts. Even so, despite recent declines, New Jersey has maintained a leading role in pharmaceuticals, with more than half of the top 20 global pharmaceutical companies operating here. However, while biotechnology has been a source of positive job growth in New Jersey, the state has struggled to grow this sector at the same rate as other leading biopharma hubs. This represents a significant opportunity to attract more companies and grow revenues.

Meanwhile the biopharma industry is evolving rapidly. Scientific innovation is leading to step-changes in the standard of care for diseases with high unmet needs (e.g., Oncology, Hepatitis C). Technology and automation are impacting manufacturing processes, as well as other parts of the value chain. Clinical and commercial models have pivoted to better address an emerging focus on the value therapies deliver to patients, health systems, and payers. These shifts mean that tomorrow's winners will look different from past winners. To be successful, New

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6 Capital IQ
7 New Jersey's Life Sciences Industry Cluster, NJ Department of Labor & Workforce Development, Summer 2017, Bureau of Economic Analysis, Moody's Analytics
Jersey must develop new capabilities and strategies, and should carefully examine the trends and their implications for its biopharma industry.

New Jersey certainly has the means to restore its leading position in the biopharma industry. This overview lays out the key points to consider in achieving that goal.

A CLOSER LOOK AT NEW JERSEY’S BIOPHARMA INDUSTRY

New Jersey is home to approximately 1,000 pharmaceutical and biotechnology companies. More than half of the 40 largest biopharma companies—primarily pharmaceutical companies—have headquarters or a major presence here. Combined, the sector contributes more than $100 billion per year to New Jersey’s output. That is 3.7% of the state’s GDP, twice the national average. The industry directly employs approximately 65,000 people and indirectly more than 300,000.

EXHIBIT 2: BIOPHARMA IN NEW JERSEY

| 3.7% | Percent of GDP (2x U.S. average of 1.9%) |
| >350,000 | Direct, indirect, and induced employment |
| 29% | Percent of drugs approved by the FDA from 2015-2017 produced by New Jersey-HQ companies (33/113) |
| 25,088 | Life sciences papers published in the NY-NJ innovation cluster in 2014 |
| 2,302 | Patents filed in the NY-NJ innovation cluster in 2014 |
| < $20 | Cost of lab space per square foot (compared to >$50 in New York City and San Francisco, and >$70 in Boston) |

8 US Census County Business Patterns
9 Capital IQ
A center for innovation

New Jersey’s concentration of biopharma makes it one of the top 10 innovation clusters in the U.S. In 2014, the cluster produced 25,000 life science publications and filed approximately 2,300 patents in 2013. In 2014, companies in New Jersey had over 1,000 drugs in development, and from 2015-2017, 33 of the 113 novel drugs approved by the FDA came from companies with Global or US headquarters in the state. Among the state’s considerable strengths in biopharma, perhaps none shine brighter than its ability to develop transformative therapies and bring them to market. The high rate of approvals is due in no small part to New Jersey’s highly educated workforce: 38.6% of adults over 25 hold a bachelor’s degree or higher, and 14.9% have a graduate or professional degree, compared with an average of approximately 31.3% holding a bachelor’s degree in the U.S. overall – and 11.9% with a graduate or professional degree. Additionally, New Jersey’s 63 colleges and universities produce more than 20,000 life sciences graduates annually, an important source of talent for the industry.

Tremendous scale but stagnating growth

Despite these advantages, New Jersey’s biopharma industry has not kept up with the rest of the country. From 1977 to 2015, the state’s biopharma industry gross domestic product (GDP) has grown by 1.1% per year, whereas U.S. biopharma GDP grew more than 4.2 percent. New Jersey’s biopharma employment growth has also stagnated, declining 0.4% per year since 1977, while employment in the industry nationally has grown 1.3%.

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12 Food and Drug Administration
13 US Census Bureau American Community Survey
14 Choose NJ
Unlike the rest of the country, biopharma employment numbers in New Jersey did not recover after the financial crisis of 2008-2009. From 2010 to 2015, it declined 2.7% per year, while U.S. employment grew 0.8% annually. Notably, New Jersey’s biopharma employment decline occurred primarily in the pharmaceutical subsector, whereas biotechnology employment grew 1.0% per year.\(^{15}\)

Specifically, the decline in New Jersey’s biopharma employment has been mainly in manufacturing: While R&D employment was flat from 2005 to 2015, manufacturing employment declined 3.6% per year. Both New Jersey’s R&D and manufacturing employment trailed most peer states.\(^{16}\)

\(^{15}\) bureau of Economic Analysis, Bureau of Labor Statistics, Moody’s Analytics

\(^{16}\) Bureau of Labor Statistics, Moody’s Analytics
### Competition for start-ups and job creation

Compounding these difficulties, during the past decade, New Jersey’s biopharma industry has experienced increasing competition from other states that were also trying to raise their quotient of biopharma start-ups. For example, California and Massachusetts have, respectively, created ten and four times the number of companies compared with New Jersey (885 biopharma companies founded in California between 2012 and 2015, 430 in MA, and only 89 in NJ)\(^\text{17}\).

This trend line is reflected in the totals. Between 2012 and 2015, there were four peer states where the percentage of start-up biopharma companies exceeded the national average of 2.5%: Massachusetts (7.3%), California (3.9%), Pennsylvania (3.4%), and Maryland (3.1%). The percentage of start-ups in New Jersey, by contrast, was only 2.1%\(^\text{18}\).

Winners of this competition receive material economic benefits, as underscored by employment, wages and economic output (all figures from 2014). The six states that employed more than 250,000 people in biopharma were among the 11 states with the highest GDP. Biopharma in the U.S. employed more than 850,000 people, with the average salary exceeding $120,000, more than twice the U.S. average in the private

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\(^{17}\) PitchBook, US Census County Business Patterns

\(^{18}\) PitchBook, US Census County Business Patterns
sector. The industry also generated over $1.2 trillion in economic output, almost 4% of the U.S. economy, and paid more than $67 billion in personal taxes.\textsuperscript{19}

The indirect economic benefits are even more striking. For every job directly provided by biopharma companies, the industry supports 4.2 indirect and induced jobs. That means 3.6 million jobs in other U.S. sectors (e.g., wholesale trade, real estate, legal services, transportation) are created as a byproduct of direct industry employment.\textsuperscript{20}

\textbf{EXHIBIT 5: BIOPHARMA START-UP ACTIVITY}

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\textbf{Lagging peers in funding for the biopharma sector}

Several sources of funding are critical for creating and growing companies, including public, venture capital, and academic. New Jersey lags peer states on all three.

The lower start-up rate in New Jersey is reflected by the low level of public funding for advancing the biopharma sector. Moreover, the state has attracted lower amounts of federal investment for small businesses relative to peer states: between 2010 and 2015, it received only 186 Small Business Innovation Research (SBIR) awards.

\textsuperscript{19} The Economic Impact of the US Biopharmaceutical Industry: National and State Estimates, PhRMA and Teconomy Partners LLC, May 2016

\textsuperscript{20} The Economic Impact of the US Biopharmaceutical Industry: National and State Estimates, PhRMA and Teconomy Partners LLC, May 2016
In addition, venture capital funding investment is an area where NJ is not keeping pace with other geographies. From 2014 to 2016, California completed 148 biopharma deals, receiving venture capital funding of $1.9Bn invested, and Massachusetts completed 105 biopharma VC deals that generated $1.8Bn invested. In sharp contrast, 19 New Jersey deals received venture capital funding investments totaling $255 million\(^{22}\). The causes and effects here are complex and related to other factors, such as fewer incubators and lower levels of funding for basic life sciences research, which are described below.

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### Small Business Innovation Research awards\(^{21}\), 2010 – 2015

<table>
<thead>
<tr>
<th>State</th>
<th>Total funding US$ mil</th>
<th>Funding per capita $ per person</th>
<th>Total # of awards</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>707</td>
<td>18</td>
<td>1,715</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>422</td>
<td>63</td>
<td>949</td>
</tr>
<tr>
<td>New York</td>
<td>209</td>
<td>11</td>
<td>445</td>
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<tr>
<td>Maryland</td>
<td>206</td>
<td>35</td>
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<td>North Carolina</td>
<td>175</td>
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<tr>
<td>Pennsylvania</td>
<td>155</td>
<td>12</td>
<td>373</td>
</tr>
<tr>
<td>New Jersey</td>
<td>89</td>
<td>10</td>
<td>22</td>
</tr>
</tbody>
</table>

US Average: 22

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\(^{21}\) US Small Business Administration SBIR/STTR Program

\(^{22}\) PitchBook
Massachusetts and California currently lead in biopharma incubators with 29 and 25 respectively, and New York has eight. New Jersey currently has only four, but is moving up the list by increasing to seven in the near-term. Today, New Jersey has 85 VC firms headquartered in the state (19 of them focused on biopharma), but attractive innovation will be needed to keep investment within state lines23.

In addition, New Jersey’s academic and public-sector biopharma research funding lags peers. Most of the funding for academic biological research is provided by grants from the National Institutes of Health. New Jersey institutions received $240 million in NIH funding in 2016, making it the 23rd ranked state. The entire state received less funding than 24 different individual academic institutions. Meanwhile, institutions in New York City and Philadelphia received almost $2.5 billion in biomedical grants in 201624.

23 PitchBook
24 National Institutes of Health
Higher cost of doing business

Since the 1990s, the cost of doing business in New Jersey has increased more than most of its peers. It is more than 10% higher than the U.S. average, primarily because of the state’s high labor costs and tax rates.25

Labor costs, however, are not necessarily the determining factor in business location decisions. Businesses thinking of moving to New Jersey may overlook labor costs if the state addresses other factors, such as the cost of living, infrastructure, regulatory constraints, and licensing requirements— all categories in which New Jersey ranks in the bottom quartile nationally.

The state’s regulatory system is highly complex. With 565 municipalities, each with its own rules for zoning and business regulation, as well as county and state regulations, the process of getting approvals can be daunting for young companies.29

At the same time, New Jersey has paid about four times more per life sciences job compared with peer states. Specifically, it has paid about $38,400 per life sciences

26 “America’s Top States for Business 2016,” CNBC.com, January 2016
29 New Jersey State League of Municipalities
job, while Massachusetts has paid less than $12,200 per life sciences job and California paid less than $9,250 per life sciences job30.

ATTRACTING BIOPHARMA COMPANIES

A large proportion of states use a variety of incentives to attract biopharma companies, especially ones that are small or in start-up mode. A holistic strategy, rather than ad hoc investment, maximizes chances of success.

Targeting through multiple mechanisms

As of 2015, 15 U.S. states offer small business innovation research matching grants to bioscience companies. Half of all states offer angel investor tax credits for investments in technology companies, including bioscience companies, and more than 70% offer research and development tax credits.31

As of 2017, 16 states offer small business innovation research (SBIR) matching grants and 25 states offer tax credits to angel investors who invest in technology companies, including the biosciences. Some states also invest directly in private venture capital firms that fund small biopharma companies.32

Massachusetts, for example, supports small biopharma creation by providing matching grants for SBIR phase II and a sales tax exemption for R&D and biomanufacturing equipment. The state also invests in biopharma companies directly through the MassVentures. Likewise, California offers state sales tax exemptions for R&D and biomanufacturing equipment, as well as exemptions for biopharma companies.

New Jersey also spends significantly on incentives, but these tend to be less biopharma focused and broader in nature. Moreover, they are frequently used to preserve existing jobs in a variety of sectors, rather than create or attract new ones.

30 Average incentive per job calculated using IncentivesMonitor database for deals from 2010-2016, including only deals in industry sector: life sciences. This calculation includes total jobs (new jobs and safe-guarded jobs). IncentivesMonitor – WAVTEQ (www.IncentivesMonitor.com)
32 Bioscience Innovation in the States: Legislation and Job Creation Through Public-Private Partnerships, Biotechnology Innovation Organization, 2017
Jump-starting a virtuous start-up cycle

Young companies have created most of the new jobs in the U.S. From 2000 to 2011, net job creation in the country came from companies less than 11 years old. The founding of biopharma start-ups follows a virtuous cycle: more companies founded leads to more companies being founded. This phenomenon allows successful states to outpace the rest once a critical mass of start-up activity is established, generally in hub cities or specially designated regions.

For example, 996 biopharma companies were founded in California between 2011 and 2015, and another 296 were founded in 2016. In Massachusetts, the number of biopharma company launches during those periods was 488 and 163 respectively. By contrast, in New Jersey, the numbers are 102 and 27.

States compete fiercely to capture a sizable portion of the sector’s employment growth. To achieve this, several have invested in incubators. Since 2000, California has more than doubled its number of biopharma incubators to more than 20.

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33 Entrepreneurship and Job Creation in the US Life Sciences Sector, Brookings Institute, 2014
34 PitchBook
Although New Jersey presently has only four biopharma incubators, there are plans for three more, in addition to a number of other supportive developments to attract companies. These developments include:

- The RU-UMDNJ merger, which has resulted in a culture and systems that encourage entrepreneurship and company creation at Rutgers University
- NJIT’s NJ Innovation Institute, which is making headway in biomanufacturing
- Rowan University’s incubator and investment fund
- The announcement of the Seton Hall-Hackensack Meridian School of Medicine
- The Institute for Life Sciences Entrepreneurship, which is supporting start-ups
- Princeton University’s soon to be opened BioLabs-managed incubator

New Jersey should also consider the type of innovator who founds new biopharma companies. Often, these are star scientists who bring therapies developed in academia to the private sector for development. These scientists frequently come from major universities and bring NIH funding. Incubators and targeted incentives have been shown to be effective in luring star scientists, again highlighting interdependencies among key factors.

In addition to luring start-ups to New Jersey, there are opportunities to bring the headquarters, clinical trials apparatus, or commercialization arms of larger companies here as well. This could include both US- and internationally-headquartered companies. While considering these options, it is important to note that states that have been successful at attracting biopharma companies have focused their incentives on the life sciences. The goal is to achieve a critical mass of infrastructure and activity that contributes to a thriving ecosystem.

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35 PitchBook, Press Search
Developing a robust attraction strategy

Despite the challenges it faces, New Jersey is well-equipped to attract new biopharma companies. Its location is appealing to companies looking to access major markets and sources of talent. Situated in the center of the Northeast corridor, which generates over 20% of U.S. GDP, it boasts proximity to New York City and Philadelphia, the largest and fifth-largest cities in the U.S.\(^{37}\). The Port of New York/New Jersey is the largest in the country as measured by the value of goods flowing in and out.

To convince biopharma companies to move to New Jersey, the State must determine where and how to invest funds. Next, it must create an integrated strategy on how best to incentivize the retention and creation of jobs in the biopharma sector and its related industries.

The state can then choose from among many options to support a robust biopharma ecosystem. These options should provide benefits over three time horizons, near-, mid-, and long-term. Below is a non-exhaustive set of potential options drawn from the analysis of historical data, the options deployed by other successful states and countries, and the suggestions of CEOs and other leaders of companies based in New Jersey and elsewhere.

\(^{37}\) *Re-seeding the Garden State's economic growth: A vision for New Jersey, McKinsey, July 2017*
As our analyses have shown, the state of the BioPharma industry in NJ is at a crossroads. Purposeful investment and a concerted public-private effort can help NJ regain its legacy of being the “medicine chest to the world” by retaining existing biopharma jobs, attracting new jobs, and sparking overall economic growth at least at the level of national biopharma growth of ~1.4% if not at the higher rate of 2-3% that some states are delivering. In the absence of that, we believe the steady decline of -1-2% will continue.

Job creation strategies must include targeted incentives, coordinated public and private effort, and structural changes that encourage founding new enterprises in New Jersey, retraining existing talent, and enticing companies from around the world to set up US operations in NJ in the near-, medium-, and long-term. We recommend 4 significant initiatives that promise to deliver the maximum impact fastest:

1. **Direct State government support** of the industry, including targeted financial incentives, tax credits, and funding private-public and academic-commercial partnerships

2. **Promotion of life science innovation and investment** in the state, including creating a new “BioPharma Super Cluster” as a hub of life science activity, most likely in North-Central NJ.

3. **Making NJ the world leader in post-graduate and mid-career Biopharma educational and training programs** that focus on retraining for manufacturing and R&D jobs that will be critical for the next decade, and are in critical short supply (e.g., advanced drug analytics; translational research; commercialization)

4. **Strengthening New Jersey’s brand**, including increased promotion and marketing of the advantages of founding or moving a company to the state.

Needless to say, additional levers such as investment in infrastructure improvement and reducing the cost to operate in NJ can also have massive impact in biopharma and overall, but experience has shown that these levers are tougher to implement quickly. We endorse these levers but have purposefully picked the above 4 which we believe provide the highest likelihood of implementation and “bang-for-the-buck.” They are also levers that span public and private efforts, and lend themselves to public-private partnerships that are critical for impact.

1. **Direct State government support**

   Short-term levers that provide financial incentives and improve accessibility to funding will be attractive to biopharma companies. For nascent biopharma companies, access to capital is a key consideration. For established companies, tax incentives play an important role in increasing attractiveness of a given market by reducing costs.

   Specific short-term actions could include:
• Increase Angel Investor Tax Credit from 10% to 25% for investment in emerging technology businesses that have 75% of employees in NJ. The program is currently capped at $25 million. The credit could be increased without increasing the cap and without increased cost to the state budget.

• Make the Grow New Jersey Assistance Program permanent and target the program to biopharma companies. This program, which offers a 10-year tax credit for up to $15,000 per job per year, is scheduled to sunset in June 2019.

• Improve the Technology Business Tax Certificate Transfer (Net Operating Loss, or NOL) program by eliminating the single sales factor as it applies to this program.

• Change R&D credits to give start-ups more access to capital. This could be done by making them a rebate on payroll taxes.

• Adopt a version of IRS Section 1202, an incentive program that rewards investments in companies with significant growth potential and synchronizes the timing of a capital investment and the angel investor’s gain from the investment.

• Fund NJ biotechs through private-public and academic-commercial partnerships.

• Provide matching funds for SBIR programs and provide expanded assistance on grant application preparation to promote New Jersey recipients of Small Business Innovation Research (SBIR funds). Such a program will enable companies to develop stronger business and operational models, while utilizing the federal SBIR program as a vetting mechanism for promising technologies.

• Create and fund targeted workforce retraining programs for displaced pharmaceutical manufacturing workers. This will enhance New Jersey’s commercialization strength and stem the “brain drain” as baby boomers begin to age out of the workforce.

In addition to the above, the state of New Jersey should consider improving infrastructure to support the industry in the long-term. These may include investment plans targeting manufacturing and heavy export zones. This is not a strength for New Jersey, and interventions may be required to bend the curve in manufacturing employment.

2. Promotion of life science innovation and investment, including creating a new BioPharma Super Cluster

Our second recommendation entails recommitting New Jersey as a center of innovation in life sciences, especially after drugs and devices enter the clinic. This lever encompasses two related ideas:

• First, create a public-private effort to seed and launch new companies focused on mid- to late-stage drug development, advanced analytics/RWE/HEOR, and product launch/commercialization. These are the areas where New Jersey is a
world leader, driven by the presence of BioPharma leaders such as Johnson and
Johnson, Merck, Bristol-Myers Squibb, Novartis, and Celgene, to name just a
few. New Jersey has the talent, and New Jersey also has the drug substrate in
the pipelines of these companies. In considering how it could create something
distinctive, New Jersey might contemplate tapping the deep pipelines of large,
established pharmaceutical companies headquartered in the state. Bringing
together seasoned R&D executives, VC leaders, and leading academics from
across the state would spark creative dialogue around how promising assets
could be “rebooted” and could be a testing ground for new ways to develop
assets (e.g., novel investment arrangements, heavy use of advanced analytics).
The state should encourage and incentivize creation of new companies focused
on clinical research, leveraging pipelines of the larger companies as mentioned,
using models such as Lilly’s CGRP and Roivant. Expanding the number of
incubators through seed funding would help to build momentum and increase
attractiveness for start-ups and entrepreneurs in the industry.

- Second, NJ should strongly consider launching a BioPharma Super Cluster with
targeted incentives and critical mass. The state today has a very strong but
loosely affiliated concentration of biopharma in North and Central NJ and
diffused presence in the rest of the state. Case studies from other countries and
states show that scale and focus make a difference. Israel is an example of a
successfully developed ecosystem with concentrated industry activity and access
to world-class research. The industry focuses on three main hubs – Tel Aviv,
Jerusalem and Haifa, all within a 2-hour drive of each other. Additionally,
world-class research entities are in close proximity, such as the Weizmann
Institute of Science, University of Jerusalem, Tel Aviv University and the
Technion – Israel Institute of Technology. In Massachusetts, the industry has
benefitted from extensive investment in the Massachusetts Life Sciences Center
(MLSC) from its founding until 2016, and has invested more than $600 million
in government funds. It has also secured more than $2.3 billion in matching
investments in the Massachusetts life sciences industry. These funds supported
a range of investments, and programs to enhance the workforce and promote
industry growth.

California’s biopharma hub in Silicon Valley is fueled by three internationally-
renowned universities (UCSF, Berkeley and Stanford) and has become a global
leader in stem cell research, supported by its public-private partnership with the
California Institute for Regenerative Medicine (CIRM) that was created to allocate
$3 billion to stem cell initiatives. NJ should seek inspiration from these and
numerous other examples and create a BioPharma Super Cluster with incentives
and infrastructure that support incubation of new companies in a concentrated area
and in designated “innovation” or “free trade” zones.

38 Capital 20.20: Advancing the region through focused investment, Upstate Revitalization Initiative, October 2015
The above ideas enforce each other and would create a self-perpetuating cycle that would further lead to strengthening academic research, attracting more NIH funding, attracting star scientists, and improving technology transfer processes.

3. Making NJ the world leader in post-graduate and mid-career BioPharma Educational and training programs

The global economy is undergoing a quantum shift in the number and types of jobs that will be required going forward, due to technological disruption. A recent McKinsey report estimated that up to 30% of the hours worked globally could be automated by 2030. This means that job loss and retraining are inescapable. NJ has already seen the disadvantages of these trends as demonstrated by the 2-3% decline in biopharma manufacturing and R&D jobs over the last decade (see Exhibit 4). But this trend can be converted to a positive via retraining and vocational education in biopharma.

This is not a new idea, but one whose time has come. The need for retraining is evident across industries, and in state-led initiatives across the U.S. that focus on improving training and promoting flexibility in the workforce. These initiatives include data and analytics-related programs and policies, such as LaunchBoard in California, a platform that provides data on progress, employment and earnings to help educators evaluate programs in terms of demand. Career search and matching tools, such as Launch My Career, funded by the U.S. Chamber of Commerce Foundation in partnership with Gallup, provides college-bound students with information on ‘hot jobs’. Numerous state-led programs also offer training and work-based learning, as well as financial aid to students. New Jersey's own New Start Career Network and ‘65 by 25: Many Paths One Future’ initiatives, as well as supportive financing measures, are good starts but require scale.

So what areas should NJ focus on? The capabilities needed to drive a thriving industry 10 years from now will look dramatically different from today’s. New Jersey should consider how public-private partnerships and universities can transform their educational strategies and focus their programs on one or more of the jobs of the future described below:

- **Advanced analytics.** The explosion in available data and computational power has enabled a step-change in data-driven decision-making across the biopharma value chain (e.g., discovery, clinical trial optimization, real world evidence). This is creating substantial demand for data scientists and engineers.

- **Patient-centric drug development.** Patients today are more informed than ever, and competition for patient enrollment in trials is ever-increasing. Winners in the future will take a patient-centric approach to their development and commercialization plans. Here, New Jersey can rely on an enviable “deep bench” of seasoned R&D executives, an advantage enjoyed by few other locations in the world in addition to a highly concentrated, diverse population for recruitment to critical trials.
- **Convergence of drug, device, and consumer technologies.** Technology is rapidly breaking down traditional lines of demarcation between pharma, med tech, and consumer health. Robotics and "connected care" that enables real-time patient interventions will change the way biopharma companies think about the value their products deliver.

- **Value and market access.** As healthcare costs continue to climb and significantly burden society, governments, health systems, and payers are becoming increasingly value-conscious in their care decisions. As a result, biopharma companies will need leaders who are well versed in the broader health ecosystem, the priorities of diverse stakeholders, and the strategies needed to secure patient access to new medicines.

As mentioned earlier, biopharma will be a net 2-3% growth industry globally and NJ should be well placed to take more than its fair share of job creation. But this will happen only if the state and its local institutions aspire to make the state the world leader in biopharma’s jobs of the future. Doing so will not only help attract high-quality employees and employers, but will also improve the quality of research and innovation needed to support the wider ecosystem.

4. **Strengthening New Jersey’s brand**

Marketing outreach that promotes advantages for biopharma companies in New Jersey represents another lever. A major focus should promote New Jersey as an attractive headquarters location for international companies planning to establish U.S. operations. New Jersey’s value proposition will be especially appealing to companies entering the late development and commercialization stages of their pipeline as the state offers a high concentration of professionals with expertise in these areas. Proactive communications – to both the public and targeted audiences – can help shape the “New” New Jersey brand.

New Jersey marketing efforts should also promote the state as an ideal location to conduct clinical trials. This industry has the potential to create jobs and add millions to New Jersey’s economy. In 2013, BioNJ found that total annual investments in clinical trials by corporate and NIH sponsors totaled $263.3 million and resulted in $779 million in economic output. Clinical trials investment supports 3,750 jobs on an annual basis, with GDP impact of $337 million. Direct wages total $142 million. Per $1 million invested in clinical trials, 15 jobs are created; $1.37 million is added to GDP. That base has strong potential for growth.

New Jersey has enormous potential to accelerate growth in biopharma and the state as a whole. If New Jersey commits to creating an environment that helps companies thrive and that attracts new start-ups and funding, its upside is considerable. The

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recommendations herein could bring jobs and more businesses that could help energize our state economy and reestablish New Jersey as the Medicine Chest of the World.

A related set of forthcoming recommendations from the New Jersey Biotechnology Task Force that was established in 2017 should also be considered.
APPENDIX

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Exhibit sources and notes

Exhibit 1: Moody’s Analytics; US Census, American Community Survey; IPEDS, NCES; US Bureau of Labor Statistics; C2ER, Emsi; FEMA; U.S. Department of Transportation; Forbes; National Institutes of Health; Pitchbook; Tax Foundation; EIA; IncentivesMonitor – WAVEEQ (www.IncentivesMonitor.com); US Census; NCES; proprietary McKinsey framework and analysis


Exhibit 3: Bureau of Economic Analysis, Moody’s Analytics. (1) Biopharma industries defined as the following NAICS codes: 3254 Pharmaceutical and medicine manufacturing, 3391 Medical equipment and supplies manufacturing, and 5417 Scientific research and development services

Exhibit 4: Moody’s Analytics (1) Defined as NAICS codes: 3254 Pharmaceutical and medicine manufacturing and 3391 Medical equipment and supplies manufacturing; (2) Defined as NAICS code: 5417 Scientific research and development services (includes some non-healthcare R&D)
Exhibit 5: Pitchbook, US County Business Patterns (Establishment data). (1) Biopharma industry defined as the following NAICs: 3254 Pharmaceutical and medicine mfg, 3391 Medical equipment and supplies mfg, and 5417 Scientific R&D services; (2) Pharmaceutical and biotechnology companies founded in the year that have received funding. Number shown is the average number of companies founded and funded per year over the period from 2012 – 2014

Exhibit 6: SBIR/STTR Program, US Small Business Administration (SBA). (1) Small businesses are defined as having 499 employees or less; (2) SBIR provides grants in two phases. Phase 1 ('start-up') provides up to $150,000 for six months of product exploration/feasibility. Phase 2 ('expansion') provides up to $1M for maximum of two years. It is provided only to Phase 1 grantees to explore commercialization opportunities

Exhibit 7: Pitchbook

Exhibit 8: National Institutes of Health, 2016. (1) Not exhaustive; (2) Funding goes to both universities and companies, e.g. Soligenix

Exhibit 9: IncentivesMonitor – WAVTEQ (www.IncentivesMonitor.com). (1) Different types of incentives include: tax, grant subsidy, loan/credit, non-financial, other/not-specified; (2) Additional incentive programs in New Jersey include the Angel Tax Incentive and the Technology Business Tax Certificate Transfer (NOL).

Exhibit 10: FDI benchmarks adjusted based on case studies; proprietary McKinsey framework and analysis. (1) General importance, specific companies may have differing priorities.
I would like to submit the following testimony for the Biotechnology Task Force please:

- Make the innovation/entrepreneurship ecosystem building effort REGIONAL. Why are NYC, NJ and PA competing with each other? It’s silly.
- One strategic direction to consider: incentivize and brand NJ as a place for the best services businesses that serve the nearby innovation centers. We should consider laying the foundation to help services businesses flourish in the Garden State. This will service the increasing numbers of virtual and semi-virtual companies (esp. those coming out of top medical centers in NYC/Philly). This would eventually lead to new startups coming into NJ to be close to where the work is done. This also speaks to the regional effort that I think is important.
- At BryoLogyx, we are based in California, but I operate out of New Jersey. We seek partners all over; however, we do value proximity as a way to promote communication.

These comments come from a person who has been passionate about building the entrepreneurial ecosystem since leaving ‘Big Pharma’ in 2012. I have contributed and continue to contribute in numerous ways to this work. Please don’t hesitate to reach out if you would like more detail or clarification.

Thank you for your consideration.
Warm regards,
Sam.

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February 16, 2018

Ms. Debbie Hart, President & CEO
BioNJ
New Jersey Biotechnology Task Force, Chair
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Dear Debbie,

The Somerset County Business Partnership is pleased to endorse the work of the New Jersey Biotechnology Task Force to support the biotechnology industry in New Jersey.

The Somerset County Business Partnership is a unique organization in that we operate as a Chamber of Commerce and also partner with the Somerset County Freeholders and the State Division of Tourism to provide economic development and tourism services to the entire business community. On behalf of the Somerset County Freeholders, we prepared a Comprehensive Economic Development Strategy (CEDS), that was approved by the United States Economic Development Administration. Our plan, Investment Somerset, a Collaborative Blueprint for Economic Growth, lays out the strategies that the private sector needs for job creation and investment. Because we went through a CEDS process, we can evaluate what state policies will achieve our economic development objectives.

As you know, the Business Partnership has endorsed the plan produced by BioNJ, The New Jersey Biopharma Industry: A Prescription for Growth. All four recommendations make sense and are supported by our CEDS objectives:

- Reform the state’s economic development incentives so they drive job creation and investment, and not based primarily on geographic considerations.

- Create a Biopharma Super Cluster hub in North Central Jersey. We will produce data documenting that the epicenter of the Hub should be in Somerset County.

- Build a stronger connection with our educational and training resources. The Business Partnership has built a strong connection with the higher education community and I would note that Raritan Valley Community College hosts New Jersey’s only standalone workforce training facility.
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- Promote the New Jersey brand. Somerset County’s brand is “Making Vibrant Connections” and will can market our brand in a way that compliments the state’s promotion.

As noted above, the Somerset County Business Partnership, in collaboration with Somerset County, will be producing a report documenting the economic opportunities that are in Somerset County in the biotechnology area. The data will be compelling. The report will show Somerset County is in a position to act as the economic engine for the entire pharmaceutical and life science industry if we make the right reforms.

Our report will contain specific recommendations on how we can work together to achieve our common objectives. Upon completion of the report, I will ask for an opportunity to present our findings to the New Jersey Biotechnology Task Force.

Respectfully submitted,

Michael V. Kerwin
President & CEO

C: Assemblyman Andrew Zwicker
   Rebecca Perkins, BioNJ
   Walter Lane, Somerset County Planning Board
   John Maddocks, Greater Raritan Workforce Development Board