Puerto Rico
Science, Technology
& Research Trust

Puerto Rico's Policy on Science, Technology & Innovation

Puerto Rico Science, Technology & Research Trust

The Puerto Rico Science, Technology & Research Trust (S&T Trust), established in 2004 under Public Law 214 as a private, non-profit entity, is charged with stimulating innovation, technology commercialization and the creation of high-technology jobs in Puerto Rico. Public Law 214 also authorizes the S&T Trust to define and implement the public policy for science, technology and research and development (R&D) for Puerto Rico. This document, Puerto Rico's Policy on Science, Technology & Innovation, is the product of a joint public-private sector effort, coordinated by the S&T Trust and the Puerto Rico EPSCorR State Committee. It presents a comprehensive approach to fostering and harnessing locally developed and protected innovation that can significantly enhance economic growth and job creation in Puerto Rico. This Policy will help guide local government agencies, private-sector entities, and higher education entities to coordinate with one another efforts aimed to help accelerate the technology development, intellectual property protection, and commercialization process in Puerto Rico. This Policy proposal includes the rationale for the proposed policy, its objectives, strategies, metrics, implementation guidelines, and progress report requirements.

http://www.prsciencetrust.org

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Preface

The Puerto Rico Science, Technology & Research Trust (S&T Trust), established in 2004 under Public Law 214 as a private, non-profit entity, is charged with stimulating innovation, technology commercialization and the creation of high-technology jobs in Puerto Rico.

Public Law 214 also authorizes the **S&T Trust to define and implement the public policy for science, technology and research and development (R&D) for Puerto Rico.**

This document, **Puerto Rico's Policy on Science, Technology & Innovation**, is the product of a joint public-private sector effort, coordinated by the S&T Trust and the Puerto Rico State Committee of Experimental Program to Stimulate Competitive Research (EPSCoR). It presents a comprehensive approach to fostering and harnessing locally developed and protected innovation that can significantly enhance economic growth and job creation in Puerto Rico.

This Policy will help guide local government agencies, private-sector entities, and higher education institutions to coordinate with one another all efforts aimed to accelerate Puerto Rico's technology development, intellectual property protection, and commercialization process. Here we describe the rationale for the proposed policy, its objectives, strategies, metrics, implementation guidelines, and progress report requirements. References and supporting documents for the Policy can be downloaded from the S&T Trust website located on the web at: **www.prsciencetrust.org**.

Summary

Need for a Policy on Science, Technology & Innovation for Puerto Rico: Innovation is the heart of economic growth. Unfortunately, only a few regions have been able to build enduring innovation ecosystems. Puerto Rico has a long history of well-intentioned efforts to harness research, development and innovation as a cornerstone of its economic development strategy, the fact remains that currently there is no guiding "blueprint" that will help coordinate and integrate these efforts. The success of the Puerto Rico S&T policy relies on enhancing the quality of the connections, linkages and relationship between people and institutions. For instance, institutions will not, and cannot generate the same economic development results because they are not embedded in the same web of personal and professional trust-based relationships that are essential to the innovation cycle. This Policy on Science, Technology & Innovation (ST&I) has been prepared to meet this need, so vital to Puerto Rico's capacity to develop and strengthen its knowledge economy.

Major Policy Objectives: The Policy is aimed at establishing guiding principles on how innovation and entrepreneurship, coupled with key strategic financing mechanisms, help to scale up the impact of successful local R&D initiatives that could generate intellectual property[1]. The Policy identifies five strategic objectives that need to be addressed *immediately* if Puerto Rico is to significantly improve its capabilities in ST&I. The following objectives will enhance the ability of local STEM (Science, Technology, Engineering and Mathematics) entrepreneurs and innovators to compete successfully in the global marketplace.

Five Strategic Objectives of the Policy

- Develop and strengthen the science, technology and innovation infrastructure in Puerto Rico.
- Improve the economy's capabilities to develop, adopt, adapt, and market new technologies.
- Strengthen society's technological capabilities and understanding of the role that science, technology and innovation play in economic development within a knowledge-based economy.
- Strengthen the Island's scientific, technology and entrepreneurial communities.
- Integrate activities in science, technology, and innovation, with economic development and competitiveness issues.

[1] *A recent USPTO report shows that intellectual property-intensive industries contribute $5 Trillion, 40 Million jobs to U.S. economy. The report can be accessed on the Internet by visiting the following address: http://www.uspto.gov/news/publications/IP_Report_March_2012.pdf*

Each of these Policy objectives includes a list of proposed strategies that could significantly enhance the strength, competency and capacity of Puerto Rico's S&T community.

Assessment and success metrics: Assessing, measuring, benchmarking, and mapping innovative capacity the interaction of culture, community, and innovation has been identified as core values driving the innovation process. Some of the indicators and statistics that must be collected and benchmarked are presented below. These metrics will be compared against published performance indicators from other countries and U.S. jurisdictions with respect to macro variables.

Indicators and Statistics to Measure Success of the Policy

- Number of ST&I and high tech jobs created.
- Export revenues generated by local ST&I companies.
- Number of incubated high tech start-ups.
- Number of high tech start-ups that scale-up and generated net profits.
- Number of peer reviewed publications in S&T journals, and intellectual property generated by research universities in Puerto Rico.
- Number of intellectual property generated by research universities in Puerto Rico.
- Number of patents granted to local researchers and inventors.
- Number of SBIR/STTR awards to local start-up companies, by phase and size of award.
- Measures of R&D investments from different sources and sectors.
- Size and strength of the S&T community.
- Create an inventory of the available S&T infrastructure and measure its development.
- Assessment of the development of the entrepreneurial ecosystem and its impact on economic development in Puerto Rico.
- Measure interactions amongst the different components of the S&T community.

Policy on Science, Technology and Innovation

The Puerto Rico Science, Technology & Research Trust is charged by Law 214-2004 to define and implement the public policy for science, technology and R&D of Puerto Rico. A task force of entrepreneurs, businesspersons, and academics developed the following Policy, Objective and Strategies. They have based its recommendations on 45 years of successes and failures in developing a working S&T Innovation Enterprise, and a thorough analysis of the experiences in a number of countries and U.S. States, which have been successful in this endeavor.

The policy builds upon Puerto Rico's strengths in the areas of education and research, its strong System of Higher Education, a strong managerial class, highly skilled human resources, strong financial institutions, and the existence of a broad industrial base that includes the following key sectors: pharmaceutical, electronics, medical devices, biotech industries, aerospace, other emerging technologies, and emerging native industries involved in different areas of innovation.

Policy: Needs

The success of the Puerto Rico S&T policy relies on enhancing the quality of the connections, linkages and relationship between people and institutions. For instance, institutions will not, and cannot generate the same economic development results because they are not embedded in the same web of personal and professional trust-based relationships that are essential to the innovation cycle. This Policy on Science, Technology & Innovation (ST&I) has been prepared to meet this need.

Competitive conditions have changed over the years from an emphasis on low labor costs and other attractions--such as tax incentives--to a renewed interest in endogenous technological and marketing capabilities. All of these are needed to meet the requirements of the global economy. The new foundations of global competitiveness are based on: (a) strong capacity to manage the complexities of new technologies, (b) the capability to understand, create, adapt, apply and market new knowledge, (c) promote effective technology transfer and (d) provide the educational and research infrastructure required to sustain these capabilities.

It has become common wisdom to indicate that competition is now based on the capacity of an economy to produce and market goods that are technology and knowledge intensive. Countries have become to a large extent creators of their own competitive advantages rather than passive beneficiaries of their given natural advantages. In becoming "creators" rather than "takers", countries must then assume a more proactive role in developing and sustaining these capabilities.

The Puerto Rico S&T Trust believes that the best path to inclusive, sustainable development is the creation of a strong, dynamic innovation ecosystem. This environment allows business enterprises to quickly adapt to the ever changing conditions of emerging challenges. We have identified the following challenges that demand our immediate attention:

- Promotion and sustaining the innovation cycle.
- The global nature of technological advances.
- Shorter product life cycles.
- Need to shorten the time it takes to bring a product to market.
- Development and marketing of new products and services.
- Accelerated rate at which new technologies are being introduced.
- Fragmented markets.
- Increasing integration of process and product technologies
- Increasing costs of developing new manufacturing technologies.

The Policy on ST&I is proposed as an instrument to harness the capabilities of government, private enterprises and the higher education establishment towards a more effective plan of action aimed at improving Puerto Rico's capabilities in ST&I, and, thus, contribute to its competitiveness.

The Policy and all interested stakeholders must recognize the complex and systemic nature of generating the conditions for the improvement of S&T capabilities. It is a process, which requires not only a profound knowledge of emerging technologies and their implications, but also developing the capacity to bring together the many institutions, both private and public, the private business sector and the academic establishment. It requires not only the academic knowledge implicit in understanding technology and its implications, but also innovation know-how and strong skills in strategy formulation, organization, and marketing. The non-linear interactions between all of these elements is what constitute the Entrepreneurial Ecosystem that this Policy seeks to develop.

The Policy serves as an indication of the importance attributed by Puerto Rico's government, academia, and private sectors to ST&I in the emerging global economic context. It will serve as powerful instruments to generate a wide consensus on the matter, which will in turn, promote the much-needed support for increasing resources to develop an Entrepreneurial Ecosystem.

The Policy on ST&I is essential to ensure that the required resources are allocated to enhance scientific, technological and entrepreneurial capabilities. The Policy also provides for assigning responsibilities and resources to an entity charged with the implementation of the Policy, it's monitoring, and taking appropriate actions to ensure that the Policy objectives are fulfilled.

Puerto Rico's rate of economic growth had fallen to around 0.3% of its GNP annually in the period between 2000 and 2009. This is in sharp contrast to a growth rate above 7% in the sixties. In the last decade (2000-2009) growth has come down to almost a stand still. In contrast, island jurisdictions similar to Puerto Rico (such as Ireland and Singapore), who were lagging behind in economic

development in the sixties have left us behind in innovation and economic development, thanks to a well thought and vigorously implemented ST&I Policy, and the development of an Entrepreneurial Ecosystem. This reality makes the development of an ST&I Policy mandatory for Puerto Rico.

Policy: Objectives and Strategies

From the Policy statement, a number of objectives and strategies can be drawn that will form an integral part of the Puerto Rico's Policy on ST&I. The objectives and strategies incorporated in this section recognize the fact that short-term needs are known and that many necessary steps for meeting these needs are at hand. Puerto Rico must bootstrap advances in this area in order to make up for lost time.

Five Strategic Objectives of the Policy

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- Integrate activities in science, technology, and innovation, with economic development and competitiveness issues.

Policy Implementation and the Role of the Puerto Rico Science, Technology and Research Trust

The S&T Trust will be guided by its Charter, as described in Law 214 of 2004 (and amended by Law 208 of 2011 and Law 67 of 2012). As stated in the Law, the S&T Trust has the responsibility of implementing the Science, Technology and Innovation Policy, and developing strategies to strengthen the Entrepreneurial Ecosystem, develop the Science, Technology and Innovation Enterprise in Puerto Rico and develop the Science District.

It is important to note that the Trust has the capacity to convene the different sectors of the S&T enterprise. The inherent advantage of the S&T Trust is that it is a private non-for-profit entity that is autonomous and governed by its own Board of Trustees. The Board of Trustees has representation from Academia, Entrepreneurs and Industry, as well as key members of the Government; six of these are appointed in an *ad-hoc* manner, guaranteeing its continuity in time. This permits continuity to the implementation of the ST&I Policy. Thus, the Trust is uniquely positioned to serve as a catalyst to form, establish and sustain the necessary alliances for successfully implementing the Policy. It will act as a coherent orchestrator to establish the required dynamic Entrepreneurial Ecosystem that is at the heart of the ST&I Policy.

During the process of Policy implementation, a central role of the S&T Trust is to serve as the focal point for the commercialization of the intellectual property, patents, and innovative processes generated by the Research Universities, High Tech Start-ups Companies, and Multi National S&T Firms. In other words, the S&T Trust should assume the responsibility of collecting key ST&I and R&D indicators in collaboration with the Puerto Rico Institute of Statistics to assess and measure the progress of the goals and objectives of the Policy in achieving Puerto Rico's competitiveness in the knowledge economy. The Trustee should periodically evaluate and assess the progress of the Policy, and when necessary, make recommendations on how to improve the Policy and adapt it to the changing internal and external realities of the S&T Enterprise and the changing markets for technological innovation.

The Policy, through the S&T Trust, will provide for coordination with pertinent government agencies, which, although not directly related to Science, Technology, and Innovation are key to Puerto Rico's development efforts. This includes: the Department of Economic Development and Commerce (DEDC), Puerto Rico Industrial Development Company (PRIDCO), the Puerto Rico Planning Board, Puerto Rico Department of the Treasury, the Puerto Rico Council on Education, the major Institutions of Higher Education in Puerto Rico, the Department of Education, the Economic Development Bank (EDB), the Government Development Bank (GDB) and the Legislature.

Puerto Rico ST&I Components

We have identified the following key components of a dynamic Entrepreneurial Ecosystem to be already in place:

- The industrial and academic sectors understand that they must act as full partners and that their fundamental task is to create and implement a policy to increase the economic growth rate of Puerto Rico and, at the same time, facilitate its insertion into the global knowledge and technology driven economy, with the government playing a supporting and nurturing role.

- All Jurisdictions that have been successful in harnessing R&D and Innovation to develop the Knowledge-Based Economy have at least one internationally competitive Research University. For this reason, the Policy will assign the responsibility to the S&T Trust to work closely with the Graduate Campuses of the University of Puerto Rico to convert them into an internationally competitive Research University.

- Many recognize the strong links that exist between the innovation process and economic development. It is also recognized that ST&I permeate modern life in its many manifestations and that it is not a separate set of activities limited to the academic sphere or R&D alone. However, most acknowledge that there must be a systemic effort to create a strong ST&I infrastructure that will promote innovation.

Objectives and Implementation Strategies

Because of the complex, systemic and multi-sector nature of the ST&I Policy, its successful implementation requires a well-defined entity to steer, incentivize, catalyze, and manage its implementation. This entity will be the Puerto Rico Science, Technology & Research Trust (S&T Trust). The S&T Trust will be responsible for nurturing, catalyzing and steering resources that will result in a functional Entrepreneurial Ecosystem.

The government's policy in the area of ST&I will be based on a systemic approach and provide the general framework for the various components of the Science and Technology Enterprise (institutions of higher education, private firms, non-government organizations, and government) to develop action plans in support of the Policy.

The initiative to implement the policy will be led by the industrial, business, and academic sectors while the Puerto Rico Science, Technology & Research role will be to serve as a facilitator and provide the necessary policies and support needed to develop the science, technology and Innovation infrastructure, the Science and Technology Community, and the innovation process. The Policy recognizes that the links between basic scientific research and technological innovation that can result in commercially viable commodities are complex and are not sequential or linear. In some instances, the process is science driven, while in others it may be market or technology driven. For this reason the Policy follows a nonlinear model of innovation.

Objective 1: "Develop and Strengthen the Science, Technology, and Innovation Infrastructure in Puerto Rico."

The Science and Technology Trust, as part of its responsibility to orchestrate and promote both human capital and infrastructure to sustain the S&T Enterprise will assume responsibility for developing the Puerto Rico Science District, and promote a virtual organization of the District with the major Research Centers and Institutes in Puerto Rico, and with Research facilities, such as: the Molecular Science Building and the Cancer Center. It will also work closely with the Research Universities in Puerto Rico to foster and promote their development into World Class Research and Innovation Universities.

Research Resources and Facilities

- Leveraging federal R&D funds through co-funding and matching funds mechanisms, and promoting partnerships between industry and academia to harness R&D funds from federal agencies to stimulate economic development and energize the innovation process; these should be a cornerstone of the S&T infrastructure building effort.

- Accelerate the development of the Science District, this will serve as a Hub to catalyze R&D and Innovation in Puerto Rico by creating a core of R&D and Innovation laboratories and facilities that will foster the Entrepreneurial Ecosystem. The Science District will establish

links with all major R&D and Innovation facilities in Puerto Rico in a virtual manner that will promote broad collaboration among the R&D and Innovation community.

- Provide additional support and resources for research facilities for all sectors involved in the innovation process.

- Develop the research facilities that are deemed necessary for Puerto Rico's economic development, establish new ones when necessary and strengthen the existing ones that are or could become competitive.

- Technology Corridors, Technology and R&D Centers and Institutes, industry related R&D Centers, and Research Institutes affiliated with Higher Education Institutions and Centers of Excellence should be considered as mechanisms of strengthening the Science and Technology infrastructure.

- Federal program's funds for S&T activity, R&D, and Technology Transfer (T2) must be harnessed to support the S&T Infrastructure.

- Cyber infrastructure is an essential element of the innovation process in the age of the knowledge economy. Since knowledge is a product in this economic model, knowledge is transferred through cyberspace. In order to facilitate the successful implementation of this Policy, it must promote the formation of a strong cyber infrastructure that will enhance the connectivity within the jurisdiction and with the rest of the world.

Education and Development of Human Capital

- In collaboration with the Puerto Rico Council on Education, promote effective integrated planning for the Higher Educational System, including both private and public institutions, in the area of Science and Technology. Stimulate the development of a truly world class Graduate Studies and Research Intensive Universities.

- Develop a plan to attract, retain, and repatriate science and technology and entrepreneurial talent to Puerto Rico, and provide them with a nurturing environment to develop science and technology R&D, innovation and marketing activities, and stimulate the development of entrepreneurship and the formation of start-up companies. Actively promote the tax incentives available to qualified researchers under Law 101.

- Universities must adopt measures to attract, retain and nurture academics with entrepreneurial aptitudes in the academic community. Universities should act in an entrepreneurial manner by establishing mechanisms and promoting the necessary legislative and regulatory changes that will permit faculty to become industrial entrepreneurs within the university. This includes the creation of university spin-off companies for the purpose of commercializing technologies, the formation of Test-beds, and incubators for university entrepreneurs to move intellectual property from the laboratory to the production stages and marketable commodities.

Fostering Interactions

- Promote the creation of consortia, the formation of industrial clusters, and adoption of regional consortia in order to achieve critical mass.

- Identify local innovation companies with the potential for fast growth and export capabilities and support and nurture them.

- The Institutions of Higher Education are urged to promote collaborative programs between them and with private industries, as well as with universities and research institutions abroad. Joint ventures with off-Island universities could prove to be a powerful instrument for the transfer of technology; strengthening of research staff; and, generally, improving links with the global science and technology community.

- Puerto Rico should seek to become a regional hub for Science, Technology and Innovation related activities in the wider Caribbean and Latin American region, including a greater role in the transfer of technology to the region.

- Establish the means that will facilitate the commercialization of R&D results through closer links between government, private firms, and the universities. These efforts must be market driven; they must identify prospective market for the product, at prices that are profitable.

Regulatory framework

- Preview existing legislation and fiscal policies which govern the Higher Education System and propose the necessary amendments to provide an environment conducive to making it a more effective actor in the area of Science and Technology and its contribution to economic development. This will include, if necessary, a revision of the laws that regulate Higher Education Institutions in Puerto Rico.

- Evaluate all regulatory and legal frameworks to make them compatible with the objective of strengthening Science and Technology Enterprise in Puerto Rico.

- Provide the required legal framework for effective copyright and intellectual property regulations that will stimulate R&D, and ensure the proper management of these regulations, providing incentives so that faculty and students engage in the generation and transfer of technologies, and that royalty funds flow both to the inventor and the institution that enables the Innovation activity to continue to fund research.

- Create a regulatory environment and provide incentives for the creation of venture capital and start-up funds for start-up companies, particularly for those in the early stages of development.

- New financial instruments and institutions must be created in the areas of seed funds, Angel investors and Venture Capital Enterprises to generate new investment in Science and Technology related economic activities.

Objective 2: "Advance Puerto Rico's Capabilities to Develop, Adopt, Adapt and Market New Technologies."

Puerto Rico's efforts in ST&I will focus on the need to be competitive in the emerging global technologies and markets. In order to achieve this objective, here we identify key areas where stakeholders should contribute to achieving our goal. The list is not meant to be exhaustive of all possibilities, but a dynamic starting point to guide our efforts.

Government of Puerto Rico

- To promote innovation and technology transfer, the industrial and academic sectors will identify areas of competency in order to form S&T clusters. The Government will create incentives to promote the formation of these clusters around the major existing and emerging industrial strengths of Puerto Rico and incorporate them into the Entrepreneurial Ecosystem.

- Generate an appropriate incentive and regulatory structure that will stimulate increased R&D activity, with potential impacts on the following sectors of the economy: life sciences; computing science and information technology; food & agriculture sciences; alternative energy & environmental sciences; electronics, aerospace & aeronautics; and efficient industrial processes.

- Tax credit to stimulate R&D activities of local start-up firms will be sustained to allow them to sell their R&D tax credit to firms or enterprises that report net profit.

- Generate conditions for firms to become learning organizations in the area of technology and technology commercialization.

- Promote the development of the necessary competencies needed to make Puerto Rico competitive in the development of new products, services and commodities, considered essential to obtain greater control of its competitive edge.

Puerto Rico Science, Technology and Research Trust

- The S&T Trust will assume a key role in the commercialization of patents and other locally developed intellectual property.

- A program--which will incorporate, among other incentives, government leveraged grants and interest-free loans--will be created to promote the adoption and adaptation of new technologies by local firms.

- A program to help high tech start-up companies obtain federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) funds will be developed to finance the R&D that this type of company need to develop, adopt, or adapt technologies needed to develop new products or make start-ups more competitive.

- The S&T Trust staff will be trained in the required skills needed to be effective in promoting and marketing technologies, and the development of high tech start-ups.

- The policy will create a favorable environment for private sector organizations to play a major role as catalysts in promoting technology transfer and taking a proactive stance in meeting the challenges of emerging market conditions.
- Recognizing that technology transfer requires the creation of networks, which include "creating" and "adopting" firms, Puerto Rico should join existing regional and global networks with these objectives in mind.

- Concentrate efforts in those areas in which Puerto Rico has core competencies or can develop these core competencies efficiently in a reasonable period of time. Whenever possible, the formation of clusters of industries will be promoted to exploit the development potential of these core competencies.

- Puerto Rico has educated a considerable number of highly talented and well prepared scientists, engineers, MD's, and business persons who have emigrated from Puerto Rico to the mainland and other countries seeking better opportunities to express their talent; and many of them have become successful entrepreneurs beyond the Island. Thus, Puerto Rico has a unique opportunity for bootstrapping its innovation process and the development of start-up companies by designing strategies that will encourage this large number of émigrés to relocate in Puerto Rico, and contribute to its economic development. The S&T Trust should design incentives to catalyze this process.

- The best way to achieve technology transfer is through highly developed persons who already master the appropriate technology. Thus, Puerto Rico needs incentives and the development of a nurturing environment that will promote scientists, engineers, and entrepreneurs with the desired talent and skills to relocate in Puerto Rico.

- The S&T Trust should develop an interactive website to serve as an electronic net to identify and engage the scientific, engineering, and entrepreneurial talent that Puerto Rico will need to enhance innovation, technology transfer, and the development of high tech start-ups in order to accelerate its economic development.

- When the S&T Trust provides funds to develop needed projects or initiatives, or leverages federal R&D funds, it will abide by the self-sustainability principle. Funds will be catalytic, the Innovation and R&D organizations will compete for these funds on a merit and peer reviewed basis. The funding will be temporary with the commitment of the recipient of the funds, to then compete in the open market for Federal Funds, Private Public Partnership (PPP), and other Private Sector funds to sustain their programs or projects.

- Puerto Rico can benefit and should build on the existing S&T, Technology Transfer (T2), and R&D federal programs to support the S&T Policy. The S&T Trust should play a major role in facilitating the commercialization of the intellectual property and patents generated by Academia. It will also identify and support local innovation industries with potential for fast growth and the capacity to export.

Private Enterprise and Academia

- Firms will be encouraged to establish links with local universities in order to carry out R&D, through among others: the creation of programs aimed at developing internships for university students and faculty in private firms, and industrial personnel in the universities; and through industrial extension and incubator facilities.
- Industries, businesses, and higher education institutions will be encouraged and incentivized to develop entrepreneurship programs for in-house product and process development or the creation of innovation pathways.

- The formation of strategic alliances between industries or clusters of industries, and between industries and academic institutions, will be incentivized and facilitated for the formation of virtual organizations to carry on R&D, Technology Transfer, and other forms of innovation that will result in enhanced competitiveness and economic development.

- Initiatives, such as those related to providing venture capital, will be strengthened in order to promote the establishment of emerging high technology intensive start-up firms that will commercialize innovations.

- The Institutions of Higher Education and industries will be encouraged to develop facilities, and the government will provide PRIDCO facilities to serve as the site of a system of incubators. Universities will be incentivized to provide technical, scientific, marketing, and other business assistance to start-ups in the incubators. These incubators will have access to R&D laboratories and Test-beds prototyping facilities that will be located at academic institutions and the private sector.

- Promote the adoption of state-of-the-art technologies through industrial extension services.

- The Department of Agriculture's activities in R&D and the Agricultural Research and Extension Services at UPR will be enhanced and steps taken to ensure that these activities respond to the objectives included in the policy on Science, Technology and Innovation.

- As part of this policy, collaborative efforts between private sector organizations, the universities, and the government will be stimulated to provide support for firms in the various sectors in adapting to new technological and economic realities, and to attract new core business.

- The Higher Education System must build upon its capabilities, including its capacity to provide state of the art quality education at the undergraduate and graduate level and increase its capacity to access federal funds in the area of R&D and ST&I in areas related to Puerto Rico's advanced and diversified industrial base.

- Universities in Puerto Rico need to develop educational programs and curricula that will promote entrepreneurial skills and attitudes in the student population.

Objective 3: "Strengthen Society's Technological Capabilities and Understanding of the Role Science, Technology and Innovation Play in Economic Development within a Knowledge-Based Economy."

The ultimate goal of the Puerto Rico Science, Technology and Innovation Policy is to achieve a fundamental cultural transformation in the way that society understands and values science, technology and innovation as a means to enhance its quality of life and economic wellbeing. Although not meant as an exhaustive list, below we identify a few points that should guide our initial efforts.

Puerto Rico Higher Education System

- Improvements in the educational system are required to ensure that the disciplines on which scientific and technological advancement depend, including entrepreneurial skills are given due weight in elementary, secondary and higher education.

- The Institutions of Higher Education should carry out a thorough review of curricula. The Puerto Rico Council on Education should facilitate this process in order to optimize the system and to provide the base for enhancing Science, Technology and Innovation content in the curriculum.

- The educational system must include, from elementary school to the university level, the development of skills and know-how on the proficient use of cyber infrastructure, informatics and telecommunications, to ensure that all students become fluent in the use of information technologies. Puerto Rico cannot permit the formation of a major digital divide among its citizens.

- The educational system, from elementary school to the university level, should incorporate into the curriculum more knowledge and awareness of the interdependence of science, technology and Innovation and their relationship to social and economic progress.

Puerto Rico K-12, Vocational and Technological Education System

- Much progress has been achieved in educational programs at the K-12 system; however efforts in this direction need to be intensified with the objective of making our population as literate and competent in science, mathematics, and language skills, as those of peer-group countries and mainland States.

- The system of technological and vocational education must be recognized as a separate component of the educational system with its own needs, its own links to the economic sectors, and its separate clientele. A review of the existing vocational and technological education should be commenced in order to create the conditions necessary for making the system more effective in achieving Puerto Rico's economic development objectives.

Puerto Rico Science, Technology and Research Trust

- Led by the S&T Trust, a broad consensus must be achieved among the leading sectors of society that Science, Technology and Innovation are important to Puerto Rico's future.

- Communication campaign through the traditional media and the emerging social media, catalyzed by the S&T Trust should be initiated. In order to inform the society at large on the importance of Science, Technology and Innovation in determining Puerto Rico's social, cultural and economic future.
- Business, the Communication Industry, and Civic Organizations will be encouraged to participate in the promotional efforts aimed at creating a broad social consensus on the importance of ST&I for cultural, social and economic development in the era of the Knowledge Economy.

Objective 4: "Strengthen the Island's Scientific, Technology and Entrepreneurial Communities."

All Jurisdictions who have been successful in developing an Entrepreneurial Ecosystem to drive the Knowledge Economy include among its key assets, a major graduate studies and research universities that carries on internationally competitive R&D and Innovation. For this reason, we propose to actively promote the use of tax credits or tax exemptions (Law 101) for income derived from external funds obtained by competitive researchers for R&D, Innovation and Educational Development, and for leaders of R&D and Innovation Institutes. In addition, we have identified the following priorities:

Higher Education System

- The need to facilitate and nurture the evolution of the three Graduate and Research campuses of UPR into a truly internationally competitive Research University that will play a key role in the development of the Entrepreneurial Ecosystem. The S&T Trust will work in close collaboration with the UPR Board of Trustees and the top management of UPR to achieve this goal.

- Promote new tax laws that will stimulate donations and endowments to Research Universities to promote their S&T infrastructure.

- Establish a program to retain and attract scientific, technological, marketing, and entrepreneurial talent.

- Secure the resources to provide world-class compensations that will make Puerto Rico attractive to scientists and engineers. The labor market for these professions is truly global and Puerto Rico must compete, not only for financial resources, but also for human resources.

- Encourage universities to establish collaborative efforts aimed at attracting S&T R&D and Innovation talent by pooling their resources, and by the establishment of joint teaching and research activities, and shared research institutes that provide the underpinning for the establishment of new science and technology industries.

- Promote the creation of endowed professorial chairs, improvement of research facilities, and the establishment of Research Institutes, are three instruments that serve to attract scientific talent to Puerto Rico.

- Define allocation criteria for resources devoted to education that will ensure that they are directed to those areas in which the assessment of the Entrepreneurial Ecosystem indicates that there is a need, for example: graduate and undergraduate programs in the areas related to Science and Technology.

- Graduate level manufacturing engineering programs should be initiated and should be well funded. Likewise, there is a need for more technically oriented graduate programs.

- Strategically create PhD's and other advanced degrees and connect them synergistically with targeted research institutes in areas where Puerto Rico needs to develop key competencies that will allow it to compete in the global economy and in future emerging technologies. Examples of this are: Computational Sciences and Engineering degrees; CIT technologies; Medical Biotechnology; Proteomics and Genomics; Manufacturing Technologies; Materials Science; Nanotechnology; High Performance Computing; and Environmental Remediation, among others.

- The Institution of Higher Education should consider creating new Professional Science Masters (PSM) as a mechanism to produce Human Resources that are specifically trained to facilitate Innovation and Technology Transfer to enhance the Knowledge Economy.

Industrial and Entrepreneurial Sectors

- Create a nurturing environment with the appropriate incentives to stimulate the relocation of science and engineering talent to Puerto Rico as entrepreneurs in the industrial high technology sector.

- Develop a system of Test-beds and incubators to attract and nurture budding entrepreneurs in the initial stages of the development of start-up companies.

- Develop a strong world-class marketing and international trade curriculum in the Business Schools of universities in Puerto Rico.

Leveraging Resources

- Government, industry, and academia will join efforts to create Research Centers of Excellence through the formation of academic and industrial partnerships that will serve to attract and retain world-class scientists and engineers.

- The Puerto Rico Council on Education should bring together all of the Institutions of Higher Education in Puerto Rico to seek ways of optimizing their resources to advance their S&T R&D and Innovation agendas, and to create new programs and curricula that will serve the development of the knowledge economy in Puerto Rico.

- Strengthen the Entrepreneurial Ecosystem to support ST&I entrepreneurs that wish to develop successful start-up companies in Puerto Rico. This will require that the appropriate

conditions exist in the universities in order to provide an attractive and supportive environment for R&D and Innovation. The absence of these conditions is what stimulates the brain drain of local scientists and engineers in the first place.

- A marketing campaign by the Puerto Rico Science, Technology & Research Trust should be developed with the assistance of the media to create awareness of the existence of a strong and vibrant S&T Community and Entrepreneurial Ecosystem that is contributing to Puerto Rico's economic development and the improvement of the quality of life.

- Using the Science District and its virtual connection to existing R&D Centers and Institutes, and Innovation and Test-beds facilities at universities, the S&T Trust will promote the formation of Research Centers/Centers of Excellence and Institutes in emerging areas of S&T that have potential for innovation in future markets for the production of new and innovative products and services.

Objective 5: "Integrate Activities in Science, Technology and Innovation with Economic Development and Competitiveness Issues."

The Puerto Rico S&T Trust believes that the best path to inclusive, sustainable development is the creation of a strong, dynamic innovation ecosystem. One of the biggest strength that the Puerto Rico S&T enterprise has is the high quality and educational level of its workforce. The following action items have been identified to harness this strength to serve as the cornerstone for future economic growth and promote new industries.

Puerto Rico Science, Technology and Research Trust

- The S&T Trust will serve as the catalyst and orchestrator of a vibrant Entrepreneurial Ecosystem by bringing together academia, entrepreneurs, industry, and government to contribute to this common goal.

- The S&T Trust will assume a leading role through its Technology Transfer Program, in identifying potential markets for the intellectual property and patents emerging from the research universities and serve as a match maker to bring the intellectual property and patents to the commercialization stage.

- Criteria used in evaluating allocation of funds and support by the S&T Trust will take into account the direct relationship between Science, Technology and Innovation activities and economic development.

- The development of joint academia, industry, and government strategic planning should be promoted to provide for diverse approaches that include short term technology transfer and longer term innovation and product development, as well as new process technologies.

PRIDCO

- In view of the fact that economic competitiveness of nations and regions is increasingly a function of their Science, Technology and Innovation capabilities and the importance of Science and Technology industries in their economies, PRIDCO has to re-conceptualize its promotional activities to take into account this new reality.

- The technological capabilities, S&T human resources, and R&D capabilities will be actively marketed abroad by PRIDCO to attract and retain high tech companies.
- Puerto Rico's efforts will be centered on those areas in which the Island has specific core competencies or to develop emerging areas of S&T with potential for economic development.

Government of Puerto Rico and its dependencies

- In recognition of the importance of ST&I for Puerto Rico's economic development, a well-defined Science, Technology and Innovation budget for the Commonwealth should be developed.

- ST&I will receive the required priority in the budget allocation process of the Government.

- Efforts will be centered on the commercial applications of R&D results, development of new technologies, technology transfer, and applied research in strategic areas. The policy will promote conditions for attracting R&D based economic activity to Puerto Rico and creating an environment in which local technology related start-ups can thrive.

- Assistance must be provided to high tech start-up companies and other S&T related industries to develop the marketing know-how that they need to become net profit making operations.

Policy Assessment: Input and Output Metrics

In order to measure and assess the impact of the Policy and the S&T Trust's role in developing an Entrepreneurial Ecosystem and achieving S&T R&D and Innovation based economic development, a system for assessment must be put in place. The recently created Institute of Statistics of Puerto Rico should assume this role in close collaboration with the S&T Trust. The Institute should use the well-established metrics and macro metrics of the Organization for Economic Co-operation and Development (OECD) and its Frascati Manual that provides Standards and Practices to Survey Research and Experimental Development relevant to this Policy.

The Institute of Statistics of Puerto Rico has already carried out a thorough study with appropriate OECD macro metrics on the strength of the R&D and Innovation activity in Puerto Rico, both in the academic and the industrial sector. The Institute, in close collaboration with the S&T Trust will develop specific indicators that will permit the monitoring and evaluation of the Policy in achieving S&T based economic development in Puerto Rico, to provide guidance for amending the Policy when the objectives set by the Policy are not being achieved. The Institute of Statistics of Puerto Rico should be responsible for keeping and updating all the macro metrics and metrics that define the R&D and Innovation and Commercialization activity in Puerto Rico.

We have identified the following indicators and statistics that are needed to measure the impact and success of the Policy:

Indicators and Statistics to Measure Success of the Policy

- Net contribution of S&T related corporations to the GNP.
- Percent of GNP attributed to high tech corporations.
- Percent of GNP devoted to R&D.
- Export revenues generated by local ST&I companies.
- Number of ST&I and high tech jobs created.
- Number of incubated high tech start-ups.
- Number of high tech start-ups that scale-up and generate net profits.
- Peer reviewed publications in S&T journals, and intellectual property generated by Research Universities in Puerto Rico.
- Number of patents granted to local faculty and inventors.
- Measures of R&D investments from different sources and sectors.
- Size and strength of the S&T Community.
- Create an inventory of the available S&T infrastructure and measure its development.
- Assessment of the development of the Entrepreneurial Ecosystem and its impact on economic development in Puerto Rico.

In addition, the following institutions will be encouraged to prepare a budget in which funds assigned to ST&RD is clearly identified. Such budgets will help facilitate obtaining funds from government sources, both local as well as federal, for these endeavors:

- The Higher Education's Institutions

- Department of Education
    - Will be required to prepare a budget, which specifically identifies resources devoted to Science, Technology and Entrepreneurial education.

- The Council on Education
    - As part of the macro metrics, needed to assess the Entrepreneurial Ecosystem should keep information about the total investment of Institutions of Higher Education in R&D and Innovation.

Expected Outcomes after Policy Implementation

The Policy on ST&I is aimed at focusing the substantial activity in the science and technology fields that are already taking place in the Island. Adoption of a Policy for the development of ST&I and its role in Puerto Rico's economic future must be a major component of Puerto Rico's economic development strategy. The Government of Puerto Rico is fully committed to developing Puerto Rico's capacity to innovate and to understand, produce and harness developments in ST&I for its economic development and social welfare. Technology is increasingly seen as the driver of economic change in the global and knowledge economy.

We expect the Policy to:

- Accelerate growth of investment in R&D and other Science and Technology activities so that the proportion of GNP devoted to them will at least equal that of our competitors.

- Raise R&D investments in Puerto Rico within five years to become 1% of the GNP. Another objective is to double R&D funding from the Federal and Puerto Rico governments within the next five years.

- Incentivize and generate substantial private industry support for R&D.

- Stimulate and attract to Puerto Rico R&D and ST&I-based industries.

- Promote homegrown innovation and technology driven start-ups.

- A change in culture is required that recognizes the value of the S&T Enterprise for economic development and the need for harnessing new resources for its development. Thus all key players must participate in a change management process to achieve the necessary cultural transformation. Therefore, nothing less than a change in the prevailing culture's vision and understanding of the role of the S&T Enterprise in enhancing economic competitiveness will be necessary for the Policy to succeed.

- Harness the S&T Enterprise so that its net contribution to the ST&I related corporations to Puerto Rico's GNP increases over time.

- Promote alliances between Government, the private sector, and academia to deploy strategies and actions that will result in enhanced economic growth and better quality of life, better jobs, health, and environment.

- Promote and implement measures that will enhance the understanding, in the population at large, of the role that science and technology plays in economic development, enhancing the quality of life, and job creation.

- Nurture and facilitate the self-organization of clusters, start-ups, and multi-sector alliances and technology corridors. Market forces will determine the success of these self-organized entities.

- Promote a substantial strengthening of Puerto Rico's Science and Technology Community and its capabilities. This will be achieved by: enhancing individual firm's capacities;

- strengthening contributions to R&D, technology transfer (T2), and innovation that will result in economic development and an improved Educational System.

- Promote the retention and attract ST&I talent, both in R&D and Entrepreneurship to strengthen the innovation process, which is a key strategic point leading to the policy's success.

- Accelerate innovation through the promotion and nurturing of high tech start-up companies.

Annual Policy Outcomes Reporting Requirement

Public Law 67-2012 mandates an Annual Report detailing the use of S&T Trust funds and the projects/activities undertaken to accomplish its mission. The Annual Report, the S&T Trust website and other communication means will be used to officially report on the progress made on the specific recommendations and initiatives described in the Policy Statement.

Law 214, Article 26-Annual Report, was amended on April 27, 2012 to require that the S&T Trust's annual report to be submitted to the Governor, as well as to the Secretaries of both legislative bodies, within 120 days of the end of the fiscal year, contain the following:

- Audited financial statements
- Complete listing of all contracts/awards and other financial transactions incurred during the reporting period.
- Complete progress report on all activities undertaken by the S&T Trust since its last report.
- Information on new initiatives, special projects, and educational activities that will help stimulate the protection of intellectual property in Puerto Rico.
- The S&T Trust's Work Plan for the next fiscal year.

The S&T Trust will utilize its Annual Report, website and other mechanisms to report on the progress made on the specific recommendations and initiatives described in this Policy Statement.

Glossary and Acronym Table

- S&T Trust: Puerto Rico Science, Technology & Research Trust
  www.prsciencetrust.org

- R&D: Research and Development

- EPSCoR: Committee of Experimental Program to Stimulate Competitive Research
  www.epscor.upr.edu

- ST&I: Science, Technology and Innovation

- STEM: Science, Technology, Engineering and Mathematics