

RESEARCH & DEVELOPMENT IN THE GREATER PHILADELPHIA REGION

EXECUTIVE SUMMARY

- DECEMBER 2011 -



Presented by:

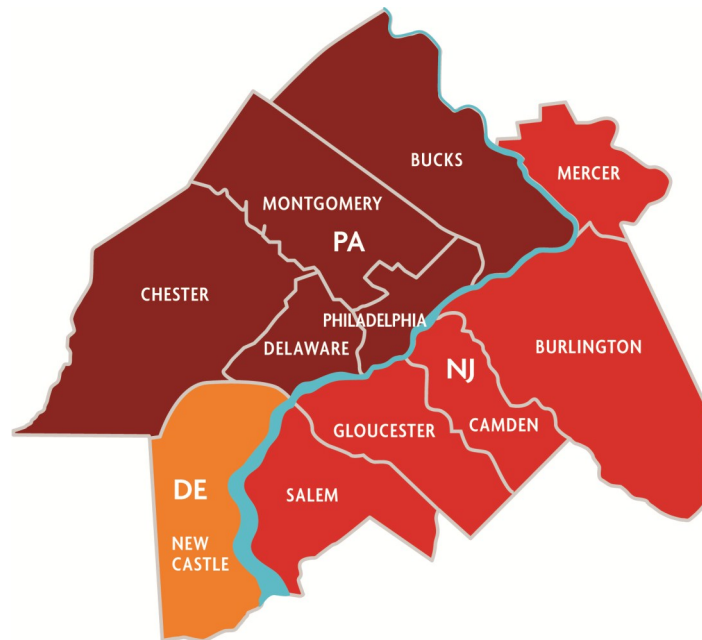
The Greater Philadelphia Region

The Greater Philadelphia region (GPR) is the tri-state, 11-county region covering Northern Delaware, Southern New Jersey, and Southeastern Pennsylvania. Strategically located midway between New York and Washington D.C., the GPR is at the center of the United States' largest consumer and business markets.

Select Greater Philadelphia (Select) is the economic development marketing organization dedicated to attracting companies to and promoting

economic growth in the GPR. In 2011, Select conducted the region's first survey of research and development (R&D) in order to determine the characteristics of the region's R&D cluster, identify the organizations that are performing R&D, and determine the types and fields of R&D activities.

R&D is a key element in regional economic growth, leading to scientific breakthroughs, new products, company formation and expansion, and attracting venture capital.



Importance of R&D Activities to Enhancing Regional Economic Competitiveness

As the U.S. has evolved toward a knowledge-based economy, the ability of metropolitan areas to expand their stocks of knowledge through R&D activities, and then to provide the systems and programs necessary to follow through to commercialization, has become an important contributor to regional economic growth. R&D is the

first step in the innovation process; metropolitan areas must also have institutions, systems, and companies that can make use of the new ideas. This study analyzed the first part of the innovation process by describing the R&D assets and activities present in the GPR.

Total R&D Spending in Greater Philadelphia

Total R&D spending in the region in 2008 was just under \$10.5 billion or 2.9% of Greater Philadelphia's GRP.

In addition, the region ranked high in terms of the economic importance of R&D spending when compared to the United States. Direct R&D spending has consistently been a higher percentage of the region's gross regional product (GRP) than that of the U.S. gross domestic product (GDP). According to the National Science

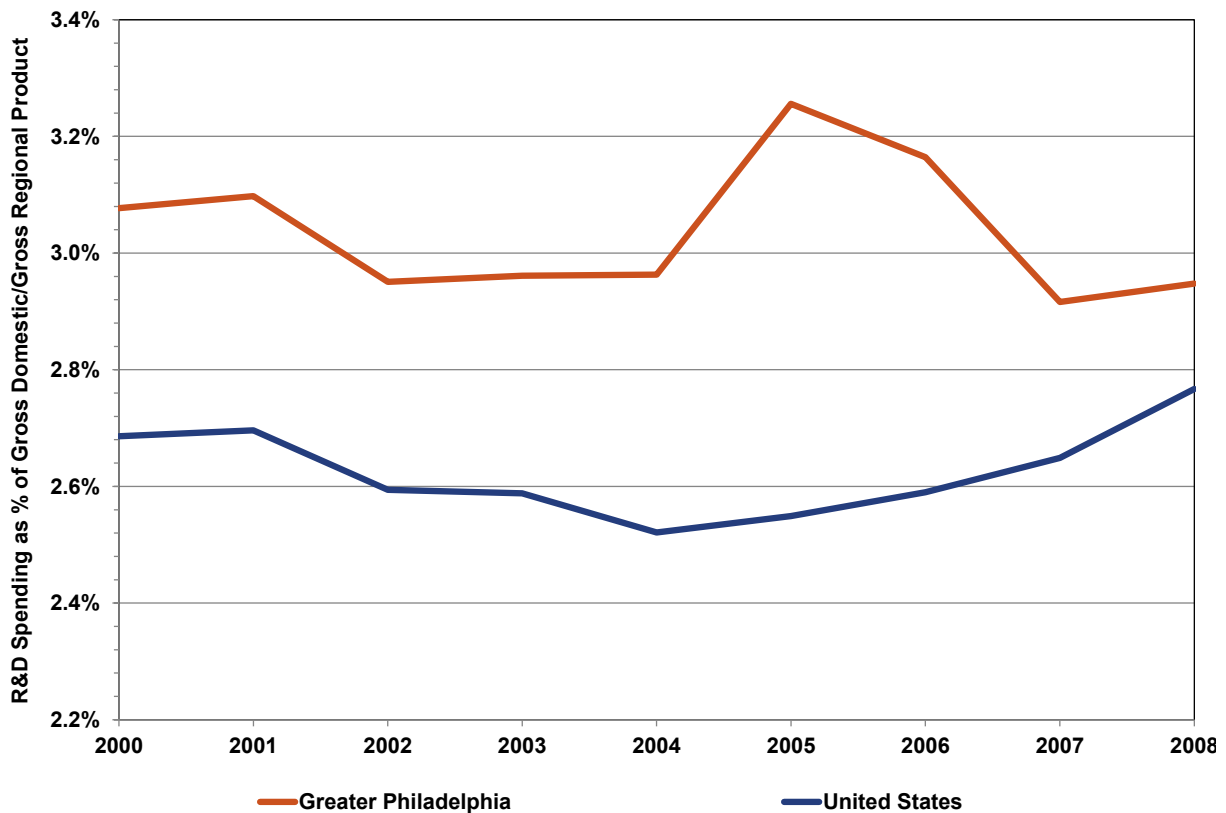
Foundation (NSF), total spending in 2008, the most recent year for which data is available, for R&D activities performed in the U.S. was \$397.6 billion, or just under 2.8% of GDP.

Select determined that in the GPR, R&D spending accounted for just over 2.9% of the GRP in 2008. (Select derived this figure by combining NSF estimates of R&D spending by industry sector or NAICS code for the U.S. and IHS Global Insight's estimates of output and employment by industry sector in the region.)

The R&D spending in the GPR was distributed as follows by the types of organizations performing the work:

Private Sector (excluding colleges & universities)	\$ 8,894,149,000	85.1%
Colleges & Universities	\$ 1,361,121,000	13.0%
Federal & State Government Facilities	\$ 201,689,000	1.9%

R&D Spending Shares



GPR Metropolitan Comparison

Greater Philadelphia was one of the top five R&D centers in the U.S. in 2008.

The primary reasons for the GPR's top-five ranking were its above-average shares of economic activity in industry sectors that spend heavily on R&D, and the large number of major R&D colleges and universities located here that collectively spent more than \$1.3 billion for R&D that year.

Select compared the R&D clusters of the 15 largest metropolitan statistical areas (MSAs) in the U.S. using 13 criteria that measured the amounts,

shares, and rates of R&D activities. The results and the ranks for the GPR are presented in the table below. The GPR's average rank across the 13 criteria was 5.3, the 3rd highest figure. The other MSAs in the top 5 (in order) were Boston, New York, Washington D.C., and Los Angeles. Boston had the highest average rank, while the average ranks for Greater Philadelphia, Washington D.C., and Los Angeles were similar.

We varied the importance of the criteria to see how the average rank scores for the MSAs were affected. When the weights for criteria measuring the amounts of R&D activities were increased, the average ranks for the MSAs in the top five went up

GPR Rankings Among the 15 Largest MSAs

	<u>Rank</u>
36 Major R&D colleges & universities	4 th
208,895 Full time equivalent enrollment at R&D colleges & universities (2008/09)	4 th
\$1,281,000,000 R&D spending at colleges & universities (2008/09)	4 th
6 Doctoral degrees awarded per 10,000 residents (2008/09)	2 nd
3,743 Total doctoral degrees awarded (2008/09)	5 th
\$1,361,000,000 NSF R&D expenditures at colleges & universities (2008)	6 th
\$1,404,000,000 National Institutes of Health R&D costs at colleges & universities (2010)	5 th
156,510 Persons employed in science & technology occupations (2009)	7 th
5.6% Percentage employed in science & technology occupations (2009)	7 th
202,416 Persons employed in top R&D sectors (2008)	7 th
7.4% Percentage employed in top R&D sectors (2008)	7 th
9.25 Avg annual patent award rate per 10,000 residents based on inventor MSA	5 th
5.6 Avg annual patent award rate per 10,000 residents based on assignee MSA	6 th

Major Private Industry R&D Sectors

Sector	Share of Worldwide R&D Costs in 2008	R&D Performed in US in 2008 (Millions of \$)	2008 GPR Employment
Pharmaceuticals and medicines	19.2%	\$ 45,126	16,527
Software publishers	9.1%	\$ 28,173	8,641
Aerospace products/parts	8.3%	\$ 27,572	5,467
Semiconductor/other electronic components	7.5%	\$ 21,693	3,543
Scientific R&D services	7.4%	\$ 19,443	29,977
Navigational, measuring, electromedical, and control instruments	4.6%	\$ 14,526	13,656
Motor vehicles/trailers/parts	6.5%	\$ 13,075	9,128
Communications equipment	4.2%	\$ 12,787	2,594
Computer systems design and related services	3.9%	\$ 12,156	39,442
Machinery	3.2%	\$ 9,903	15,032
Computers/peripheral equipment	3.3%	\$ 9,236	1,991
Telecommunications, Internet service providers, Web search portals, data processing services	2.4%	\$ 7,517	30,753
Chemicals, excluding Pharmaceuticals	2.7%	\$ 7,322	16,923

Source: National Science Foundation, 2011. Science and Engineering Indicators 2010. Table 1: Worldwide sales, R&D expense, and R&D costs paid for by others, by selected industry: 2008

IHS Global Insight. September 2010. Business Markets Insights Data Base.

because of their large sizes, while Chicago moved into the top 5 with Washington, D.C. a close 6th. By contrast, when the weights for criteria based on shares and rates were increased, Boston and Greater Philadelphia remained in the top five; New York and Los Angeles fell out; and the average ranks for San Francisco, and Seattle rose significantly, placing them in the top five.

R&D spending by private industry, excluding colleges and universities is heavily concentrated in a small number of sectors. According to the NSF, in 2008, over 80% of R&D spending worldwide and in the U.S. by private industry, excluding colleges and universities, was by the 13 sectors listed in the table above. These industries had the highest levels of R&D spending, and were also the most intensive sectors based on R&D spending as a percent of sales. Even within these 13 industry sectors, R&D spending is heavily concentrated; the top five

sectors accounted for 50% of all private industry R&D spending in the U.S. in 2008.

In 2008, we estimate that private industry, excluding colleges and universities, accounted for 85.1% of total R&D spending in the GPR, compared to only 72.7% for the US. The higher share of private industry R&D spending in the GPR is due to the above-average concentrations of economic activity in some of the major R&D sectors, including: pharmaceuticals; other chemical manufacturing excluding pharmaceuticals (basic chemicals, resins and fibers, plastics, etc.); navigational and control instruments; scientific R&D services; computer systems design and services; software; and telecommunications, internet services providers, and related services. Significant amounts of R&D in the GPR are performed by industries in addition to the 13 major sectors listed above, giving the GPR a balanced and diverse R&D cluster.

Characterizing Greater Philadelphia's R&D Sector

In order to obtain additional detailed information about the characteristics of the GPR's R&D cluster, Select conducted a survey of approximately 1,000 organizations known to perform, or likely to perform R&D in the region, including: federal government facilities, research centers and institutes at colleges and universities, private-sector companies, and non-profit organizations. We received 125 valid responses from the survey for a response rate of 12.6%. Of those, 105 currently perform R&D activities in the GPR. Additionally, 80 respondents indicated the field of activity that they perform in the region.

The types of organizations that answered our survey and conduct R&D in the GPR are distributed as follows:

- Federal government - 2
- College or university - 45
- Private, non-profit - 16
- Private, for-profit companies - 42

We asked organizations to give detailed information about the types of research that they conduct including the field of research. Top sectors that our respondents identified are biotechnology, economics, health, and medicine.

Top Fields of R&D Activity

Field of Research	Number
Biotechnology	8
Economics	6
Health	6
Medicine	6
Product Development	5
Business	5
Aerospace	4
Energy Efficiency	4
Engineering	4
Environment	4
Market Research	4
Materials	4
Optics / Imaging / Photonics	4

For these fields of research, we asked respondents to identify the R&D activities performed for each. The three types of R&D activities are:

Basic Research is experimental or theoretical work undertaken primarily to acquire new knowledge, or enhance the understanding, of the underlying foundation of phenomena or observable facts without any particular application or use in mind.

Applied Research is original investigation undertaken to acquire new knowledge or understanding to meet a specific objective or need. Compared to basic research, it has a shorter timeframe before results can be practically applied.

Experimental development uses existing knowledge, some of which may have been obtained from basic or applied research, and experience, to produce new goods or services; to substantially improve existing goods and services; or to devise new production processes, including the development and testing of prototypes.

The majority of the respondents indicated that they conduct applied research; many also conduct basic and experimental development.

Types of R&D Activities

Type of R&D Performed	Number	Share
Basic	70	31.1%
Applied	89	39.6%
Experimental Development	66	29.3%

We also asked respondents to describe the facilities that they used to conduct research. More than 80% reported that they conduct research in an office environment. Other top responses for facility type include wet labs, dry labs, and classrooms or lecture halls.

Types of Facilities

Type of R&D Facility	Number	Share
Office	70	83.3%
Lab-Wet	33	39.3%
Lab-Dry	27	32.1%
Classroom	24	28.6%
Lecture Hall	19	22.6%
Workshop	14	16.7%
Outdoor	9	10.7%
Industrial Facility	9	10.7%
Clean Room	8	9.5%
Hospital	3	3.6%
Other	2	2.4%

The respondents were asked if their facility was capable of handling special materials such as radioactive, hazardous, or infectious. Since biotechnology, health, and medicine were among the top fields of research, not surprisingly, a number of respondents are capable of handling special materials.

Types of Special Materials Used

Type of Material	Number	Share
Radioactive	14	17.5%
Hazardous	25	31.3%
Infectious	12	15.0%
Total	51	

Examples of R&D in Greater Philadelphia

Several R&D programs are exemplary of the wide range of activity in the GPR:

Aviana Molecular Technologies (AMT). The firm is a development stage company that is producing and marketing a new generation of innovative, highly sensitive and specific, state-of-the-art Biosensors specifically targeting point-of-care (POC) diagnostic products for human healthcare and veterinary medicine.

Greater Philadelphia Innovation Cluster (GPIC). The region was awarded a \$122 million grant in fall

2010 by the U.S. Department of Energy to establish the GPIC at the Philadelphia Navy Yard. This hub is at work on integrating smart materials, designs, and systems to tune building usage to better conserve energy, as well as maximizing the functioning of lighting, heating, air conditioning, and electricity to reduce energy demand.

Lockheed Martin. The company has performed a number of alternative energy R&D projects at its Moorestown, New Jersey facility including: the feasibility of a utility-scale photovoltaic power plant; the design of several types of test beds to assess the feasibility of concentrated solar power (CSP) systems, and the feasibility of offshore thermal energy conversion to generate electricity.

Princeton University, Geophysical Fluid Dynamics Laboratory (GFDL). This facility, which is operated through a partnership with the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) is one of the world's premier centers for climate research and modeling. GFDL develops and uses mathematical models and computer simulations to improve our understanding and predictions of the atmosphere, the oceans, and the climate.

University of Delaware. Working with a grant from the Army Research Office, the Department of Civil and Environmental Engineering is researching the design of composite materials to resist the devastating effects of explosive blasts. The work focuses on optimizing the material properties as well as the geometry of blast-resistant composite structures to mitigate collapse and contain debris.

Wistar Institute & Helen F. Graham Cancer Center Partnership. These two organizations have entered into a historic collaboration on translational cancer research with the aim of bringing the latest discoveries in cancer research to patients in the community. Wistar announced the construction of a new, \$100 million research facility in September 2011.

Select Greater Philadelphia acknowledges with sincere appreciation the following corporations, foundations, organizations, and government partners that make our work possible.

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