

# TOWARD A NEXT



## KEY INDUSTRIES HAVE ONLY BEGUN TO RESHAPE AN ALREADY REVITALIZED PITTSBURGH.

**P**ittsburgh's story could have ended decades ago. When the once-dominant steel industry collapsed in the 1970s and '80s, the backbone of Pittsburgh's economy evaporated. Jobless rates spiked. People left the region. Industrial and manufacturing sites languished and decayed, embodying the Rust Belt moniker that would befall Pittsburgh and too many other American cities. But Pittsburgh's story didn't end there.



# GENERATION ECONOMY





**S**uch times were a low point for a once proud and productive city. Yet Pittsburgh wouldn't lie in defeat. After all, a city that forges steel amid flames and furnaces also kindles resolution and grit. Steel production is gone, but our industrial knowledge, skills, and spirit have evolved to form the basis of Pittsburgh's cutting-edge manufacturing and technology sectors.

Many point to Pittsburgh's "eds and meds" industries as the drivers of Pittsburgh's recovery and most visible sectors behind its now bustling economy. Given the region's 60+ regional colleges, universities and post-secondary institutions and its explosive health care growth, it's easy to see why. But there's much more to Pittsburgh's economic landscape, as business and growth diversity more than anything else—more than any one sector—now defines the region's success.

From medical therapies to overcome the burden of diseases to new manufacturing techniques integrating robotics to breakthroughs in autonomous vehicle operations, Pittsburgh now has the capacity and resources to conceive these innovations.

Of equal importance to the creation of these technologies is the capacity for their deployment. As a region, we invent health care technologies while also leading the practice of health care. We employ robotics and develop new manufacturing processes for companies

to harness. Such innovations are born in and widely used throughout Pittsburgh. But their proliferation to other American cities and international populations underlies their true economic potential, letting Pittsburgh put its reimagined, reinvigorated stamp on the world.

Further, leveraging ideas, data, research, and other building blocks behind fields like energy, robotics, and life sciences has led to the creation of a markedly different and robust regional economy characterized by jobs and careers in cutting-edge fields. Not only is Pittsburgh witnessing the commercialization and spread of its innovations, we are witnessing just how transformative these ideas can be when they comprise the basis of not only your new economy, but your new identity.

## **Life Sciences: A biotech boom long in the making.**

According to reports from Innovation Works, a local investor of early-stage companies, funding for Pittsburgh tech companies has grown from about \$231 million in 2008 to nearly \$688 million in 2017. While these figures include multiple industries, the life sciences sector has been a key player in Pittsburgh's technology community for years.

In 2002, the Pittsburgh Life Sciences Greenhouse formed to catalyze the biotech community in Pittsburgh. The PLSG is an investment and business incubator organization focused on the creation, commercialization, and

advancement of life sciences companies and ideas. It has worked with more than 480 companies and invested nearly \$22 million in more than 80 companies, drawing more than \$1.5 billion in additional capital to the region.

The birth and sustaining of Pittsburgh's life sciences industry has relied on two essential components, says PLSG president and CEO Jim Jordan: the creation of medical and health care technology at universities and the commercialization of those technologies. In both arenas, Pittsburgh remains well-suited. If an invention or idea cannot ultimately be commercialized, its benefits will languish on the lab bench, never reaching the patient population.

"The culture of research and technology creation is a different culture and infrastructure and asset base than commercialization," Jordan says. Therefore, technology creation and commercialization must successfully synergize, and, at this intersection, Pittsburgh has become fertile ground.

The University of Pittsburgh (Pitt), Carnegie Mellon University (CMU), and other institutions have generated a range of health care IT and biomedical devices that have branched off into independent and successful companies or have been integrated into budding companies. Organizations such as Innovation Works and Pitt's Innovation Institute have helped numerous regional researchers, inventors, and even students transform their ideas and technologies into viable enterprises.

# FEATURE

## Leading IT Companies in the Pittsburgh Region

Company	Website	Description	Est. Regional Employment
AEC Group	<a href="http://www.aecgroup.com">www.aecgroup.com</a>	Technology consulting	130
All Lines Technology Lantek	<a href="http://www.all-lines-tech.com">www.all-lines-tech.com</a>	Technology consulting	227
Amazon	<a href="http://www.amazon.com">www.amazon.com</a>	Online retail	125
Ansys	<a href="http://www.ansys.com">www.ansys.com</a>	Simulation software	500
Apple	<a href="http://www.apple.com">www.apple.com</a>	Software development	50
Aptiv	<a href="http://www.aptiv.com">www.aptiv.com</a>	Autonomous vehicle R&D	150
Argo	<a href="http://www.argo.ai">www.argo.ai</a>	Autonomous vehicle R&D	200
Aurora Innovation	<a href="http://www.aurora.tech">www.aurora.tech</a>	Autonomous vehicle R&D	200
Branding Brand	<a href="http://www.brandingbrand.com">www.brandingbrand.com</a>	Mobile commerce technology	120
CA Technologies	<a href="http://www.ca.com">www.ca.com</a>	Technology consulting	178
Careform	<a href="http://www.careform.com">www.careform.com</a>	Technology to specialty pharmacies	150
CECity.com	<a href="http://www.cecocity.com">www.cecocity.com</a>	Healthcare technology	100
CIBER, Inc.	<a href="http://www.ciber.com">www.ciber.com</a>	Technology consulting	200
Cogent Infotech	<a href="http://www.cogentinfo.com">www.cogentinfo.com</a>	Technology consulting	100
Compunetix	<a href="http://www.compunetix.com">www.compunetix.com</a>	Conferencing applications	248
CSC	<a href="http://www.cscglobal.com">www.cscglobal.com</a>	Technology consulting	100
Confluence	<a href="http://www.confluence.com">www.confluence.com</a>	Fund administration and reporting technology	130
Consolidated Communications	<a href="http://www.consolidated.com">www.consolidated.com</a>	Telecommunications infrastructure	120
Crown Castle	<a href="http://www.crowncastle.com">www.crowncastle.com</a>	Telecommunications infrastructure	2,800
Creehan & Co.	<a href="http://www.creehan.com">www.creehan.com</a>	Healthcare technology	163
Duolingo	<a href="http://www.duolingo.com">www.duolingo.com</a>	Online translation applications	150
Dynamics, Inc.	<a href="http://www.dynamicsinc.com">www.dynamicsinc.com</a>	Interactive payment cards	100
Electronics for Imaging	<a href="http://www.efi.com">www.efi.com</a>	Imaging technology	125
Expedient	<a href="http://www.expedient.com">www.expedient.com</a>	Data centers	120
Facebook	<a href="http://www.facebook.com">www.facebook.com</a>	VR and Internet Research	50
Fujitsu America	<a href="http://www.fujitsu.com">www.fujitsu.com</a>	Technology consulting	275
Google	<a href="http://www.google.com">www.google.com</a>	Internet	600
Honeywell (Vocollect)	<a href="http://www.vocollectvoice.com">www.vocollectvoice.com</a>	Voice software solutions	380
IBM	<a href="http://www.ibm.com">www.ibm.com</a>	IT Services	100
M*Modal	<a href="http://www.mmodal.com">www.mmodal.com</a>	Healthcare technology	160
Microsoft	<a href="http://www.microsoft.com">www.microsoft.com</a>	Software and Servers	105
Modcloth	<a href="http://www.modcloth.com">www.modcloth.com</a>	Online retail	300
NetApp	<a href="http://www.netapp.com">www.netapp.com</a>	Hybrid cloud data services	250
Netronome	<a href="http://www.netronome.com">www.netronome.com</a>	Server-based networking	118
Online Stores, Inc.	<a href="http://www.onlinestores.com">www.onlinestores.com</a>	E-commerce	100
OpenArc	<a href="http://www.openarc.net">www.openarc.net</a>	IT staffing and app development	121
Petuum	<a href="http://www.petuum.com">www.petuum.com</a>	Artificial Intelligence	150
Plus Consulting	<a href="http://www.plusconsulting.com">www.plusconsulting.com</a>	Technology consulting	110
Progeny Systems	<a href="http://www.progeny.net">www.progeny.net</a>	Defense technology	120
Pyramid Consulting	<a href="http://www.pyramid-group.com">www.pyramid-group.com</a>	IT staffing and consulting	115
Questeq	<a href="http://www.questeq.com">www.questeq.com</a>	Education technology	101
RDX (Remote DBA Experts)	<a href="http://www.rdx.com">www.rdx.com</a>	Remote DBA services	200
SAP	<a href="http://www.sap.com">www.sap.com</a>	Enterprise software	600
SDLC Partners	<a href="http://www.sdldapartners.com">www.sdldapartners.com</a>	Technology consulting	363
Summa CGI	<a href="http://www.summa-tech.com">www.summa-tech.com</a>	Custom software development	500
TEKsystems, Inc.	<a href="http://www.teksystems.com">www.teksystems.com</a>	IT staffing and services	275
Tele-Tracking Technologies	<a href="http://www.teletracking.com">www.teletracking.com</a>	Patient flow logistics	273
Tollgrade Communications, Inc.	<a href="http://www.tollgrade.com">www.tollgrade.com</a>	Broadband products and solutions	118
Uber	<a href="http://www.uber.com">www.uber.com</a>	Autonomous vehicle R&D	700
VITAC	<a href="http://www.vitac.com">www.vitac.com</a>	Captioning, subtitling, and accessibility services	150
Wombat Security Technologies	<a href="http://www.wombatsecurity.com">www.wombatsecurity.com</a>	Cybersecurity	150

Source: Pittsburgh Regional Alliance, Pittsburgh Business Times Book of Lists 2017-18

Note: The Pittsburgh Regional Alliance 10-County Region includes Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington and Westmoreland counties.

## FEATURE

Without Pittsburgh's research-heavy universities, the regional life sciences sector quite simply could not have achieved its current heights or the proliferation of its groundbreaking medical technologies. The universities are the makers behind the life sciences technology, driving 21st century medicine and health care, and their research budgets (while not exclusively earmarked for life sciences development) reflect a deep focus on life sciences

investments and capital and complying with highly regulated government safety and practice standards.

Still, the pieces are all there, Jordan says; it's sometimes just a matter of fostering the right collaborations and getting organizations across the life sciences spectrum connected to maximize economic impact and jobs growth. "To leverage these high-value assets, the economic development communities need to work well together," Jordan says.

needs related to cancer, Alzheimer's disease, multi-drug resistant bacteria, rare genetic disorders, and other areas.

After identifying a prevalent and intractable health issue, the question for LifeX becomes, what technology can lessen the burden of this disease? From there, building a company around such technology—or partnering with a company already possessing it—and delivering a solution is the overall target. According to Stephan, who is also a



innovation. In the past decade, Pitt, CMU, and Duquesne University have attracted nearly \$10 billion in research funding. But Pittsburgh doesn't just draw in research dollars. It also invests and spends significantly on development; the region has spent more than \$730 million annually in life sciences research and development, according to the National Science Foundation.

Success, however, does not come easily. Out of 100 life sciences startup companies stemming from the universities, only 35 will make it past initial growth stages and be able to solidify into young companies, says the PLSG's Jordan. Yes, a good idea and necessary health solution must underlie any life sciences company. But taking that idea and commercializing it is a significant undertaking that involves accruing

Dispersing the life sciences technologies developed in the region on a global scale is a far reaching but not out-of-reach goal. At the end of 2017, Pitt's Graduate School of Public Health founded LifeX to leverage life science innovation at Pitt and the region, and its headquarters opened in Pittsburgh's Strip District earlier in 2018. The organization brings life sciences startups and the private sector together to produce solutions for some of the most complex ailments and challenges in medicine.

LifeX's mission may be vast, but its aspirations are direct: deliver new biotechnology products aimed at reducing suffering and death caused by the world's largest unmet health needs, says Dietrich Stephan, LifeX CEO and founder. LifeX's initial cohort of companies will combat unmet health

professor of human genetics at Pitt, there's no better place than Pittsburgh to carry out these plans. "Our interest is in curing diseases, and we believe that Pittsburgh is the place in the United States to do it," he says.

Part of what makes Pittsburgh so appealing for a company like LifeX is the rankings strength of its research-heavy institutions, Stephan says, pointing to Pitt's ranking fifth in annual funding received from the National Institutes of Health. Further, CMU's computer science program has been deemed number one by multiple rankings.

While the region's life sciences scene is no secret anymore, it remains ripe for further development and even the branding of its own prosperous reputation. This potential, Stephan

A close-up, low-angle shot of the da Vinci Surgical System's robotic arms. The white, articulated arms are suspended in a dark environment, with blue light reflecting off their joints and the metallic surgical instruments they hold. The instruments are long, thin, and have precision tips. The background is dark, emphasizing the mechanical complexity of the system.

# Taking the open-heart out of surgery.

AHN is the only center in the Pittsburgh region using the da Vinci<sup>®</sup> Surgical System to offer robotic mitral valve surgery. This minimally invasive alternative to conventional open-heart surgery can take on even the most complex procedures, all without opening a patient's chest.

**#LivingProof** of innovation.



**Allegheny**  
Health Network

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says, helps set Pittsburgh apart from areas like Boston or San Francisco, which are already hubs for life sciences companies but carry the weight of their own entrenched reputations and ways—Pittsburgh, by comparison, offers something fresh and flexible.

Having the resources in place to more nimbly react to and foster emerging life sciences innovations has already helped technologies and researchers make it past the volatile early days and stages of

and the amount of investment dollars flowing into Pittsburgh. Stephan says that success will correlate with a global reduction in disease and suffering—a plausible undertaking considering Pitt's and the region's historical successes. "Ultimately, in a 10-year timeframe, measuring the impact that we've had on reducing suffering and death on the global stage, that's how we will be measured in terms of success," Stephan says. "If you think about our history, I

Southwestern Pennsylvania sits atop trillions of cubic feet of natural gas locked within the sprawling Marcellus Shale natural gas reserves underground – with even more resources in the Utica Shale in nearby northeastern Ohio. The past decade has witnessed significant extraction of and economic activity surrounding all of this natural gas, putting the Greater Pittsburgh region's energy industry in the spotlight. From large-scale industries and businesses



creating a company and commercializing technology. One such example is DiaVacs, a clinical stage biotechnology company developing a novel immunotherapy approach to re-induce tolerance in type 1 diabetes, among other autoimmune diseases. Previously, researchers at Pitt developed a therapy aimed at curing juvenile diabetes, but the technology languished for more than a decade; the region lacked the infrastructure and ability to move the innovation outside of the university. Now, after LifeX took a closer look, it quickly formed a company around the idea and acquired investors. Recently, the technology entered phase II clinical trials in San Diego to further test its efficacy in patients.

While still in its early days, LifeX will focus on scaling up the number of companies created and supported

don't think it's audacious. We cured polio. We pioneered liver transplantation. That's the mindset that LifeX has in its work, impact at that scale."

### **Energy: Powering the future.**

Southwestern Pennsylvania has historically been an energy powerhouse. The coal industry fueled the manufacturing and industrial tide behind Pittsburgh's days as a steel-making giant. Coal and traditional fuel sources remain a robust feature of the greater Western Pennsylvania economy and even its culture. But diversity defines the region's energy portfolio today, integrating traditional energy reserves and alternative energy sources to deliver more efficient, innovative means of powering the region.

to transportation trucks and people's homes, natural gas remains such a sought-after resource because of its low-cost efficiency and clean-burning properties.

The economic benefits of this rich resource extend beyond Greater Pittsburgh. According to a recent report by Chevron and Peoples Natural Gas, the entire state of Pennsylvania could grow its GDP by as much as 9 percent over the next 10 years by fostering and encouraging companies to harness natural gas and boosting in-state demand, enabling downstream economic benefits from the abundant natural gas. Many industries and business pursuits, like advanced manufacturing and even data processing, require significant energy, making southwestern Pennsylvania a convenient location, to say the least.

## Leading Advanced Manufacturing and Materials Companies in the Pittsburgh Region

Company	Website	Description	Est. Regional Employment
AK Steel	<a href="http://www.aksteel.com">www.aksteel.com</a>	Steels and Steel Products	1,400
Alcoa, Inc.	<a href="http://www.alcoa.com">www.alcoa.com</a>	Aluminum, Automotive/Construction/Electronic Products	1,800
Allegheny Technologies, Inc.	<a href="http://www.alleghenytechnologies.com">www.alleghenytechnologies.com</a>	Metal Alloys/Shape Products/Components	2,900
American Beverage	<a href="http://www.ambev.com">www.ambev.com</a>	Beverages	400
Ampco-Pittsburgh Corp.	<a href="http://www.ampcopittsburgh.com">www.ampcopittsburgh.com</a>	Plastics Processing Machinery, Forged/Cast Steel Rolls.	380
Anchor Hocking Corp.	<a href="http://www.anchorhocking.com">www.anchorhocking.com</a>	Retail Glass Products	400
Ansaldo STS USA	<a href="http://www.ansaldo-sts.com">www.ansaldo-sts.com</a>	Integrated Transport System Products	590
Bayer Corp.	<a href="http://www.bayerus.com">www.bayerus.com</a>	Raw Materials, Pharmaceutical/Biological Products	1,500
Bechtel Group	<a href="http://www.bechtel.com">www.bechtel.com</a>	Energy Sources, Chemical/Energy Facilities, Metals	3,000
Black Box Corp.	<a href="http://www.blackbox.com">www.blackbox.com</a>	Communications/IT Products and Solutions	400
Bombardier	<a href="http://www.bombardier.com">www.bombardier.com</a>	Trains and Planes	770
Calgon Carbon Corp.	<a href="http://www.calgoncarbon.com">www.calgoncarbon.com</a>	Air/Water Purifiers, Activated Carbon	385
Carmeuse Lime & Stone	<a href="http://www.carmeuse.com">www.carmeuse.com</a>	Lime and Limestone	170
Caterpillar	<a href="http://www.cat.com">www.cat.com</a>	Heavy Machinery/Attachments/Parts, Power Systems	400
City Brewing	<a href="http://www.citybrewery.com">www.citybrewery.com</a>	Beverages	400
Covestro	<a href="http://www.covestro.us">www.covestro.us</a>	Polymers, High Performing Plastics	750
Curtiss Wright	<a href="http://www.cwfc.com">www.cwfc.com</a>	Energy Industry Valves/Pumps/Electronics	1,000
Eaton Electrical	<a href="http://www.eatonelectrical.com">www.eatonelectrical.com</a>	Electrical Components, Electronics	1,300
Elliott Group	<a href="http://www.elliott-turbo.com">www.elliott-turbo.com</a>	Turbomachinery	1,260
Ellwood Group	<a href="http://www.ellwoodgroup.com">www.ellwoodgroup.com</a>	Heavy Metal Components	675
Emerson Process Management	<a href="http://www.emersonprocess.com">www.emersonprocess.com</a>	Analytic/Control/Measurement Technologies, Operation Systems	800
Hussey Copper	<a href="http://www.husseycopper.com">www.husseycopper.com</a>	Copper and Copper Alloys	N/A
HVL/Douglas Laboratories	<a href="http://www.douglaslabs.com">www.douglaslabs.com</a>	Nutritional Supplements	450
II-VI	<a href="http://www.ii-vi.com">www.ii-vi.com</a>	Engineered Materials, Optoelectrical Components	460
Kennametal	<a href="http://www.kennametal.com">www.kennametal.com</a>	Construction/Mining Products, Engineered Components, Metalworking Tools, Powdered Materials/Equipment	1,300
Koppers Holdings Inc.	<a href="http://www.koppers.com">www.koppers.com</a>	Carbon Compounds, Chemicals, Treated Wood Products.	125
KraftHeinz	<a href="http://www.kraftheinzcompany.com">www.kraftheinzcompany.com</a>	Food and Food-Related Products	800
L.B. Foster Co.	<a href="http://www.lbfoster.com">www.lbfoster.com</a>	Rail/Construction/Tubular Products	110
Matthews International	<a href="http://www.matw.com">www.matw.com</a>	Memorialization Products	900
Mine Safety Appliances Co.	<a href="http://us.msasafety.com">us.msasafety.com</a>	Safety Products, Gas Detectors, Thermal Imaging	1,300
Mitsubishi Electric	<a href="http://www.meppi.com">www.meppi.com</a>	Electrical and Electronic Products/Systems	800
Mylan, Inc.	<a href="http://www.mylan.com">www.mylan.com</a>	Generic/Specialty Pharmaceuticals	500
NOVA Chemical	<a href="http://www.novachem.com">www.novachem.com</a>	Plastics and Chemicals	400
Oberg Industries	<a href="http://www.oberg.com">www.oberg.com</a>	Precision Components and Tooling	630
Penn United Technology	<a href="http://www.pennunited.com">www.pennunited.com</a>	Precision Manufacturing Solutions	580
Perryman Co.	<a href="http://www.perrymanco.com">www.perrymanco.com</a>	Titanium Products	395
Philips Respironics	<a href="http://www.respironics.com">www.respironics.com</a>	Sleep/Respiratory Devices	1,650
Polyconcept North America/Leeds	<a href="http://www.polyconcept.com">www.polyconcept.com</a>	Promotional Materials	950
PPG Industries, Inc.	<a href="http://www.ppg.com">www.ppg.com</a>	Coatings	2,200
Siemens	<a href="http://www.usa.siemens.com">www.usa.siemens.com</a>	Automation/Building/Drive/Healthcare/Voltage/Mobility Technologies	1,600
Spang	<a href="http://www.spang.com">www.spang.com</a>	Magnetic Components/Materials	600
Starkist	<a href="http://www.starkist.com">www.starkist.com</a>	Seafood	100
Tegant Corp., Protexic Brands	<a href="http://www.tegrant.com">www.tegrant.com</a>	Consumer Packaging	900
Thermal Windows and Doors	<a href="http://www.thermalwindowsanddoors.com">www.thermalwindowsanddoors.com</a>	Windows and Doors	450
TMK IPSCO Steel	<a href="http://www.ipsco.com">www.ipsco.com</a>	Tubular Products	700
Treehouse Foods	<a href="http://www.treehousefoods.com">www.treehousefoods.com</a>	Food and Beverages	600
Tru-Food Manufacturing	<a href="http://www.trufoodmfg.com">www.trufoodmfg.com</a>	Chocolate/Granola/Snack Products	500
United States Steel Corp.	<a href="http://www.ussteel.com">www.ussteel.com</a>	Metals	5,100
Universal Stainless & Alloy Products Inc.	<a href="http://www.univstainless.com">www.univstainless.com</a>	Specialty Steels	345
Veka Inc.	<a href="http://www.vekainc.com">www.vekainc.com</a>	Vinyl Extrusion	420
Wabtec Corporation	<a href="http://www.wabtec.com">www.wabtec.com</a>	Rail/Transit Products	500
Westinghouse Electric Co.	<a href="http://www.westinghousenuclear.com">www.westinghousenuclear.com</a>	Nuclear Components	5,600
World Kitchen Consumer Products	<a href="http://www.worldkitchen.com">www.worldkitchen.com</a>	Cooking/Kitchen Products and Materials	425

Source: Pittsburgh Regional Alliance, Pittsburgh Business Times Book of Lists 2015-16. 6.28.2016

[www.pittsburghmetroguide.com](http://www.pittsburghmetroguide.com)

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The sprawling transportation industry remains one of the industries most visibly linked to energy. While its large-scale conversion to energy sources outside of fossil fuels has been slow, states like Pennsylvania have led progress, says Morgan O'Brien, president and CEO of the natural gas service provider Peoples Natural Gas. Peoples has partnered with the state of Pennsylvania and with other entities to install some 20 compressed natural gas fueling stations throughout the state within the past year. The stations allow natural-gas powered vehicles to refuel without relying on traditional gasoline or diesel fuel.

In people's homes in the Pittsburgh area and beyond, residents pay less for natural gas heating partly because of their proximity to the region's abundant gas reserves. Yet, expanding the natural gas infrastructure and network of delivery pipes has been a primary goal for Peoples. "There is still a significant amount of rural communities that historically we haven't been able to serve with natural gas," O'Brien says. But by connecting towns of 500 or 1,000 people at a time, Peoples has recently been expanding its gas delivery network to reach some additional 5,000 homes a year, O'Brien says.

Beyond its abundance and economic potential, natural gas in the region has been increasingly explored as a diverse energy source. While renewable energy sources like wind and solar power often oppose traditional energy sources, they harbor real potential to work together. "We're seeing more and more projects where people are thinking of them in combination, a combination of renewable energy along with natural gas," O'Brien says. "The nice marriage is when you combine [wind or solar] technologies with the natural gas technology, you can sort of have the best of both worlds."

Fuel cell technology can harness solar and natural gas to provide constant, efficient energy. Peoples, O'Brien says, has partnered with Watt Fuel Cell, a regional venture, to explore using the technology to power homes. The fuel

cell works similar to a battery. Without burning the natural gas, it creates a chemical reaction that generates electricity. The "waste" produced is potable water, and the heat generated can be captured and harnessed. With the fuel cell in place, a home can draw energy from the fuel cell, the battery, and solar panels, relying on what may become a ubiquitous technology.

### **Manufacturing: Building on a proud past.**

Anyone who remembers when the fires from Pittsburgh's steel mills burned out in the '70s and '80s may be surprised to see how Pittsburgh manufacturing has more than just rekindled: it's roaring. Smoke stacks and heavy industry have made way for robotics, 3D printing, and other components of a far nimbler, modernized manufacturing landscape.

Pittsburgh has the skilled workforce to propel industry and engineering, the industrial sites and buildings to house companies, and an underlying network of organizations like Catalyst Connection and the Pittsburgh Technology Council that work to improve growth and development of regional manufacturers and tech companies.

As documented by the Allegheny Conference on Community Development—a civic leadership organization improving Pittsburgh's economic future—since 2010, Pittsburgh has seen more than 300 manufacturing-related company expansions or relocations. In the 10-county region, global manufacturing firms like Alcoa Corporation and Boeing Company operate alongside smaller, tightly focused companies producing industrial tools, additive manufacturing products, electronic components, and many other materials and items. In 2017, \$165 million was invested into Pittsburgh manufacturing.

Not long ago, Pittsburgh's rise and expertise in robotics and manufacturing drew the attention of a city with considerable weight: Washington, D.C. The federal Manufacturing USA initiative has sought to increase U.S. manufacturing competitiveness and

promote manufacturing research and development. The program consists of 14 institutes across the United States, and, in January 2017, the government selected Carnegie Mellon University to house the newest institute, the Advanced Robotics for Manufacturing (ARM) Institute.

ARM, a national, membership-based consortium, is headquartered in Pittsburgh because of the region's combined robotics, AI, and manufacturing aptitude, says Suzy Teele, head of marketing and communications at ARM. The institute doesn't build robots but instead funds technology and workforce-development projects to facilitate implementation of robotics into the manufacturing environment.

Robotics have long been a component of the industrial workplace but only in a narrow number of industries, such as aerospace and automotive production, says Teele. Currently robots are, frankly, complex to operate, inflexible at tasks, and expensive. Sure, certain big companies can work within such constraints, but for the bulk of U.S. manufacturers—small- to medium-sized companies—robots remain out of reach.

ARM wants to change that.

"Our goal is to get the technology that's in place today refined to a point where it can be commercialized faster and used by manufacturers in the United States," Teele says. By working with a variety of regional organizations and manufacturers, ARM acts as a collection point for collaborators to submit their ideas. ARM asks, what are the sought-after capabilities and tasks for robots to perform in the manufacturing setting? It aims to transform the answers and ideas it gets in response into reality. For example, we can envision the machinery of a robotic assembly line moving and manipulating big sheets of metal to produce, say, automobiles. But how well can those big, strong mechanical hands pick up something soft and fragile? Often, not so well. Improving robots' gentle touch is the goal of one of ARM's projects.

And what of robots taking over human jobs? It's true that automation has the potential to replace or greatly change

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## Leading Life Science Companies in the Pittsburgh Region

Company	Website	Est. Regional Employment
Aesynt	www.aesynt.com	500
ALung Technologies	www.alung.com	20
Bayer HealthCare	www.healthcare.bayer.com	800
Berkley Surgical Corp.	www.berkleysurgical.com	120
Best Nomos	www.nomos.com	15
BioTronics Inc.	www.biotronics.com	260
ChemImage Corp.	www.chemimage.com	60
Cook Vascular	www.cookgroup.com	150
DynaVox Technologies	www.dynavoxtech.com	260
E.A. Fischione Instruments Inc.	www.fischione.com	65
ERT	www.ert.com	100
Fresenius	www.fresenius.com	500
Haemonetics Corp.	www.haemonetics.com	210
Helomics Corp.	www.precisiontherapeutics.com	110
HVL/Douglas Labs	www.douglaslabs.com	N/A
Instrumentation Industries Inc.	www.iiimedical.com	35
Interpace Diagnostics	www.interpacediagnostics.com	35
Kadmon Pharmaceuticals LLC	www.kadmon.com	60
McKesson	www.mckesson.com	400
Mylan	www.mylan.com	500
Net Health	www.nethealth.com	110
Novum Pharmaceutical Research Services	www.novumprs.com	135
Oberg Industries	www.oberg.com	125
Omnyx	www.omnyx.com	100
PerkinElmer Genetics	www.perkinelmergenetics.com	50
Philips Respironics	www.respironics.com	1,600
Quest Diagnostics	www.questdiagnostics.com	700
RJ Lee Group	www.rjlg.com	160
TandemLife	www.tandemlife.com	30
The Tomayko Group LLC	www.tomaykogroup.com	100
Thermo Fisher Scientific	www.thermofisher.com	1,600
Tobii DynaVox	www.tobiidynavox.com	150
Waters Corp	www.waters.com	50
Xodus Medical Inc.	www.xodusmedical.com	75
Zoll	www.zoll.com	850

Source: Pittsburgh Regional Alliance, Pittsburgh Business Times Book of Lists 2015-16. 6.28.2016

certain jobs and tasks. However, Teele reminds us to keep things in perspective. Automation has been around for hundreds of years. As technology advances, jobs disappear while new jobs are created. Look back at the 1960s or even '80s and '90s; how many jobs from those decades have become obsolete?

In the age of automation, people and robots will work together, Teele says. Robots don't mind performing rote, boring, and unsafe tasks. People, on the other hand, can better think through

problems and perform many other responsibilities better left to the minds (if not the hands) of humans.

As a member of the ARM Institute and a founding academic institution of the federal America Makes initiative, Robert Morris University (RMU) is leading some of the region's most innovative developments in additive manufacturing.

Additive manufacturing, which involves 3D printing, creates components and mechanisms used in a variety of

industrial goods and roles. Instead of removing and cutting away layers and materials to shape a part or product, additive manufacturing builds up layers and materials to form a product, says Maria Kalevitch, dean of RMU's School of Engineering, Mathematics and Science. The process entails making 3D objects from a digital file. The technique plays an important economic role because it enables greater flexibility and customization in the production of specific-needs products and components that industries can purchase.

Pittsburgh is ideally suited for additive manufacturing (and other forms of advanced manufacturing) because of the growing presence of manufacturers in the region, its academic strength, and its customer base. "We're still a manufacturing hub, but it's not the manufacturing hub of your grandfather," Kalevitch says. "Anything you name that goes into new technology is here in Pittsburgh. I do believe that this is a renaissance for this age."

After receiving a grant, RMU began working with the regionally based Schroeder Industries to 3D print filters for cleaning hydraulic fluids and diesel fuel, among other uses. As part of Pittsburgh's Energy Innovation Center, RMU is also building a 3D printing lab for research application and workforce teaching and training.

Pittsburgh's economy relies on preparing the next generation workforce, and RMU offers the only accredited degree in manufacturing—a bachelor of science degree program—in Pennsylvania. "STEM disciplines are really the underpinning of any civilization," Kalevitch says. "It is really the advances in technology that move us forward." By capitalizing on the region's strong manufacturing sector, the school has

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sent a number of students to begin their careers at the new \$32 million General Electric additive manufacturing facility in Findlay Township, Kalevitch says.

### **Health Care for Pittsburghers — and the world.**

Certain industries within Pittsburgh's leading sectors have quite visibly established themselves in pockets of the city and beyond. For example, the Strip District bordering Downtown has given rise to "Robotics Row." The area, bordered by the Allegheny River, comprises former warehouses, foundries, and factories revitalized into headquarters and facilities for numerous tech firms born in or relocated to Pittsburgh. The sector has even been dubbed Pittsburgh's mini Silicon Valley.

Yet if there's one industry that's ever-present and visible throughout the 10-county region (and beyond), it's health care. Health care and the life sciences industries account for nearly 10 percent of the gross regional product,

according to Allegheny Conference data, and employ around 133,000 people. Regional health care giant UPMC employs some 80,000 people, making it the largest non-governmental employer in Pennsylvania. Pittsburgh also awards more than 7,500 health care-related degrees annually from its colleges and universities.

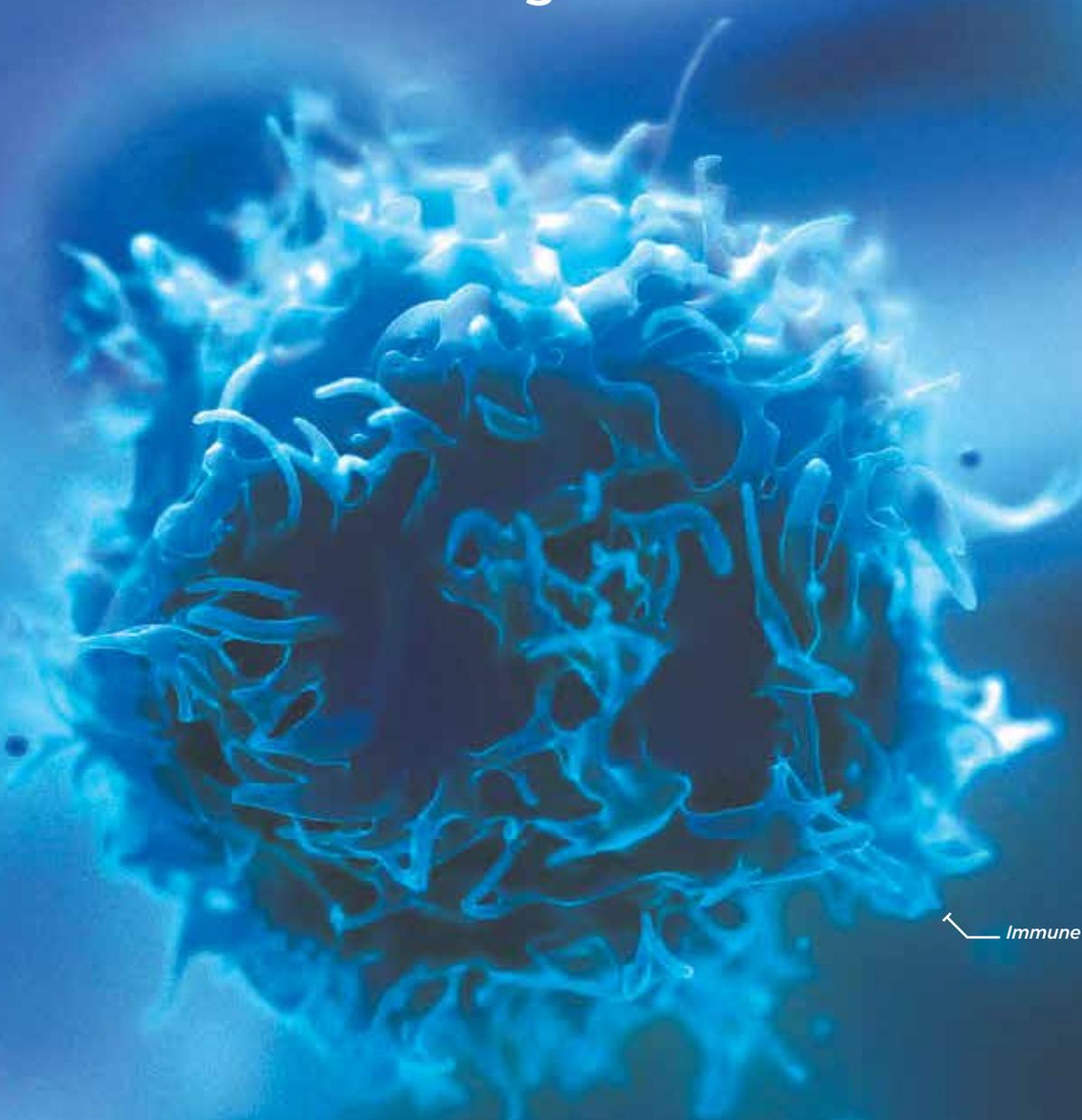
Maintaining a running list of hospitals and care facilities in the region can be challenging, if only because so many new hospitals and care facilities have sprung up, with more on the way. In 2017, UPMC announced the creation of three new specialty hospitals: UPMC Heart and Transplant Hospital, UPMC Hillman Cancer Hospital, and the UPMC Vision and Rehabilitation Hospital. A \$2 billion investment, the three hospitals' construction will take place on the sites of three existing UPMC hospitals in the Oakland, Shadyside, and Downtown areas. Aside from the many cutting-edge specialty services and treatments that these new hospitals will provide, they

also aim to cut through the complexity that befalls both patients and clinicians navigating the modern health care system.

In addition to the three hospitals, UPMC announced at the beginning of 2018 the construction of the planned \$200 million UPMC Immune Transplant and Therapy Center. The center will focus on advancing immunotherapy, a form of cancer treatment that stimulates and harnesses the body's own immune system to fight cancer.

Building such grand and transformative hospitals puts Pittsburgh's population at the epicenter of tomorrow's health care capabilities. Having advanced treatment in our own backyard provides many benefits for Pittsburghers. However, Pittsburgh's health care expertise is known outside the borders of the Steel City and even beyond the state of Pennsylvania. In fact, people and patients come from around the world to access Pittsburgh's health care. Such demand has made the region a destination for "medical tourism."

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*The UPMC Immune Transplant and Therapy Center is a partnership between UPMC and the University of Pittsburgh.*

# FEATURE

## Leading Energy Companies in the Pittsburgh Region

Company	Website	Description	Est. Regional Employment
ABB Group	www.abb.com	Electrical Components	200
Alpha Natural Resources	www.alphanr.com	Mining and Natural Gas	700
Basic Energy Services	www.basicenergyservices.com	Oil & Gas Well Services	110
CalFrac Well Services	www.calfrac.com	Well Services	340
Caterpillar	www.caterpillar.com	Mining Machinery	400
Chevron Corp	www.chevron.com	Natural Gas Production and Distribution	700
Coen Oil Co.	www.coenoil.com	Petroleum Distribution	350
Columbia Gas of Pennsylvania	www.columbiagas.com	Natural Gas Distribution	670
Consol Energy Inc	www.consolenergy.com	Coal and Natural Gas	1,400
Curtiss Wright	www.curtisswright.com	Critical Process Valves	1,000
Direct Energy Business	www.business.directenergy.com	Commercial and Retail Energy Distribution	300
Duquesne Light Holdings	www.duquesnelight.com	Electricity Distribution	1,375
Eaton Electrical	www.eatonelectrical.com	Energy Management	1,300
Elliott Group	www.elliott-turbo.com	Turbomachinery	1,260
Emerson Process Management	www.emersonprocess.com	Industrial Controls	800
EQT Corp.	www.eqt.com	Natural Gas and Distribution	950
Falcon Drilling	www.falcondrilling.com	Drill Services	325
FirstEnergy Corp.	www.firstenergy.com	Electricity Generation and Distribution	1,300
FTS International (Frac Tech)	www.ftsi.com	Well Services	340
Halliburton	www.halliburton.com	Oil & Gas Exploration and Production, Geothermal Energy	300
Joy Mining Machinery	www.joy.com	Mining Machinery	300
Kennametal	www.kennametal.com	Surface/Underground Mining Equipment	1,300
MarkWest Energy Partners	www.markwest.com	Natural Gas Pipelines	220
Mitsubishi Electric	www.meppi.com	Electrical Components	800
MSA	www.msasafety.com	Mining Safety Equipment	1,300
Noble Energy	www.nobleenergyinc.com	Oil & Gas Exploration and Production	140
Nova Chemicals Corp.	www.novachemicals.com	Plastics and Chemicals	400
Pennsylvania Transformer Technology	www.patransformer.com	Power Transformers and Voltage Regulators	320
People's Natural Gas	www.peoples-gas.com	Natural Gas Distribution	1,300
Range Resources Corp.	www.rangeresources.com	Mining and Natural Gas	475
Rockwater Energy Solutions	www.rockwaterenergy.com	Water Management	270
Rosebud Mining Co.	www.rosebudmining.com	Coal	300
The Williams Companies	co.williams.com	Natural Gas Processing	275
TMK IPSCO	www.tmk-ipsco.com	Tubular Steel	700
Westinghouse Electric Co	www.westinghousenuclear.com	Nuclear Energy Manufacturing and Engineering	5,600
XTO Energy (ExxonMobil)	www.xtoenergy.com	Oil & Gas Exploration and Production	160

Source: Pittsburgh Regional Alliance, Pittsburgh Business Times Book of Lists 2015-16. 6.28.2016

And yet, much of Pittsburgh's health care innovations and expansions center on improving and expanding health care access to people within and just beyond the 10-county region. While Pittsburgh's Downtown and surrounding neighborhoods have hosted many of the region's hospitals and medical centers,

the expansion of the suburbs over time has resulted in areas with limited access to hospital-based services. By filling in these gaps, the reach of Pittsburgh's health care becomes undeniably comprehensive, covering the city's population and more.

Moving hospital access closer to home improves the economics, the quality, and the service and outcomes of health care, says David Goldberg, Allegheny Health Network's senior vice president for administration. Regional health care provider Allegheny Health Network (AHN) has also recently announced

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significant investment involving construction of new hospitals, including four neighborhood hospitals to be built during the next couple of years. Often called “micro hospitals,” the four facilities will serve as full hospitals with eight to 10 emergency room bays and 10 beds for short stays.

Yes, the four hospitals will be small by comparison to some of the region’s medical facilities—but that’s the point. Such neighborhood hospitals will be far more economical, efficient, and able to deliver hospital services to very targeted areas, Goldberg says. The four hospitals will be built in Hempfield Township, Harmar Township, McCandless, and Brentwood Borough. The hospitals will each cost only \$17 to \$30 million to construct.

“The cornerstone of our strategy is to bring care closer to home. So, with the neighborhood hospital platform, the whole goal was to bring access to those who have limited access either to hospitals or to medical services,” Goldberg says. “We can do it faster and cheaper and focus the level of care to what the community needs.” While the Harmar facility will be close to a new outpatient center in Fox Chapel that offers imaging, lab, and physician services, the other three locations will have connected medical office buildings to bring additional medical services and outpatient care abilities.

The efficiency of the four planned hospitals also reflects advances in the way health care is delivered, Goldberg says. In many cases and medical scenarios, patients spend less extended time and less time overall in the hospital today. “Pittsburgh continues to be an expert in health care delivery,” Goldberg says. “But also, the way health care is delivered today is becoming much more outpatient, or ambulatory.”

A couple decades ago, patients receiving hip or knee replacement procedures might spend a week or more in the hospital for the surgery and recovery. Today, thanks to advances in surgical techniques, therapy, and overall care, many procedures don’t require such extensive hospital stays—even giving

birth used to involve a much longer stay. Therefore, hospitals can put greater focus on outpatient care, as with the four planned AHN hospitals.

While AHN’s four neighborhood hospitals will center on treating common ailments and injuries, some medical procedures and sick patients require the magnitude and resources of a larger hospital. AHN announced in 2017 plans to construct a 160-bed full-service hospital in Pine Township adjacent to its Wexford Health + Wellness Pavilion. Patients in need of critical care and more extensive procedures will be directed toward the Pine hospital, among existing and other facilities. In sum, the construction of these five new hospitals are part of a \$1 billion capital investment project that also includes the expansion and renovation of existing AHN facilities, several new cancer centers, as well as significant investment in Erie, Pennsylvania, north of Pittsburgh.

### **Autonomous vehicles and the technology of tomorrow.**

Pittsburgh drivers share the road with numerous Port Authority buses, bicyclists, and, since 2016, driverless autonomous vehicles. Pittsburgh is the leading development hub and citywide testing grounds for autonomous automobile development. Since Carnegie Mellon University pioneered

autonomous vehicle technology more than three decades ago, the region has subsequently attracted companies, including Uber, Argo AI, Aurora, and others, driven to leverage, advance, and proliferate driverless autos.

When Uber rolled out its autonomous vehicle ride sharing in 2016 on the city’s streets, the prospect of hailing an Uber and being ferried in a self-driving car (a human driver remained for added safety) afforded Pittsburghers a chance to experience one of Pittsburgh’s technological marvels in an unprecedented way.

Decades worth of research at CMU and many other institutions and organizations had gone into getting autonomous vehicles operational for the road. And, as big as a feat as that is, some Pittsburghers, if not the American population at large, can’t help but wonder: How soon until these driverless cars really take over our roads? When will riding in an autonomous vehicle be as common as, well, riding in one that’s not?

But it could still be quite a while until we have autonomous vehicles capable of driving on any roads and in any conditions, says Martial Hebert, director of Carnegie Mellon’s Robotics Institute, who has long studied computer vision and perception for autonomous systems. Much like new human drivers, self-



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driving cars have to learn how to drive in different environments. A car used to driving a city block may have trouble on a mountain road, for example. A self-driving car's performance and safety relies in part on data, and we simply don't have data from every driving environment and scenario, Hebert says.

While Uber's self-driving fleet has provided numerous rides (making Uber one of the most visible developers of autonomous driving technology), how we measure and validate this technology's performance—in regards to not only Uber's cars but, really, any self-driving vehicles—can still be complicated. Autonomous vehicles comprise so many mechanisms and technological pieces, from sensors to vision systems to numerous computer components, that getting everything in sync takes no small effort. "We can evaluate the performance of individual components," Hebert says. "The problem is evaluating the performance end-to-end of the entire system."

Uber's autonomous ride-sharing vehicles have been collecting large amounts of

valuable data as they ferry passengers, as have other companies' autonomous vehicles as they operate on test tracks, roads, and other environments. This data is a vital resource for making improvements and developments to self-driving technology. The sensory information and data from each ride given and route driven can be leveraged to further improve safety and validate performance. The data also has particularly high value when collected from real-world scenarios.

While self-driving cars and the innumerable technologies surrounding their development continue to be refined, we have already witnessed the commercial and economic gains and further potential that can be derived from these innovations.

Among the numerous companies CMU has done work for, two prominent examples in the realm of autonomous vehicles are Caterpillar and John Deere. The university worked on developing autonomous vehicles and systems for construction and farming use, respectively. Self-driving vehicles are

much more mature within these fields, Hebert says, because their environments are more predictable and sometimes less complex—absent are wayward pedestrians and unpredictable human drivers common to any city street.

CMU has produced many startup companies born out of technology developed at the school. And while autonomous vehicles remain a most visible embodiment of this technology, many related technological developments harbor significant commercial potential, even if less apparent. "These days there's a lot of hype and a lot of focus on driving, but in fact the applications of these kinds of basic building blocks is much broader," Hebert says.

Often, certain systems and industrial processes that use older technologies can benefit from the introduction of more cutting-edge technology, like the addition of machine learning or vision systems. These technological add-ons can harbor transformative commercial potential, Hebert says, without



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overhauling existing systems. For example, CMU developed technology that involves using sensors to predict maintenance needs, which the U.S. Air Force has since adopted. Technology to anticipate repairs can end up saving a lot of money and boosting efficiency, Hebert says.

Carnegie Mellon University, ever an innovator in education, recently launched the world's first artificial intelligence degree program. Designed for undergraduates, the program will combine sociological and technical knowledge to teach students how to transpose large amounts of data into actions and decisions to be learned by machines such as autonomous vehicles and more. Further emphasizing its capabilities for foresight, the university will ensure the program imparts ethics and social responsibility surrounding the field while it is still in its infancy; students will also assess how their technology behaves and look to correct any biases that it demonstrates.

### **Pittsburgh's pursuit.**

Pittsburgh's story is a comeback story, a comeback that took only a few decades to reach a resolution and successful outcome after a tumultuous chapter. Of course, that's a simplified analogy and, more importantly, the story goes on. A comeback implies a turnaround, the attainment of some level of success and stability at the opposite end of the spectrum. However, no one yet knows the extent of Pittsburgh's comeback.

All indicators point to a city on the rise climbing toward a still distant plateau. While the spotlight falls on the achievements of Pittsburgh's bustling tech economy and cutting-edge industries, the traits behind this success are remarkably simple: instead of wallowing in the loss of steel, Pittsburgh quickly opened to change. Further, the city leveraged its existing assets—strong universities, modern industry, technological embrace—during the 1990s and turn of the century to spark the region's current renaissance.

The ability to build on success and

growth flowed through this period of change and remains a fundamental component of Pittsburgh's continued growth. The basic formula even appears the same today: research and development of new ideas and technology begets funding, new jobs, and the creation or attraction of new companies and further growth. Multiplying this pattern large scale across a defined region produces staple industries, which in turn create strong cities—like Pittsburgh.

Among the many highlights of the Pittsburgh region's comeback, growth is in and of itself the most exciting feature because it has an exponential effect. Across every sector, across every field, innovations give rise to more data, new ideas, and new findings still unexplored. Pittsburgh may be part of a renaissance or revolution or some monumental shift too broad for a single-word summary. But the creation of a next generation economy should not be seen as a destination. Rather, its constant pursuit remains our ultimate aspiration and continued marker of success. **mg**



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