

# Ohio

## Third Frontier

### 2008 Annual Report

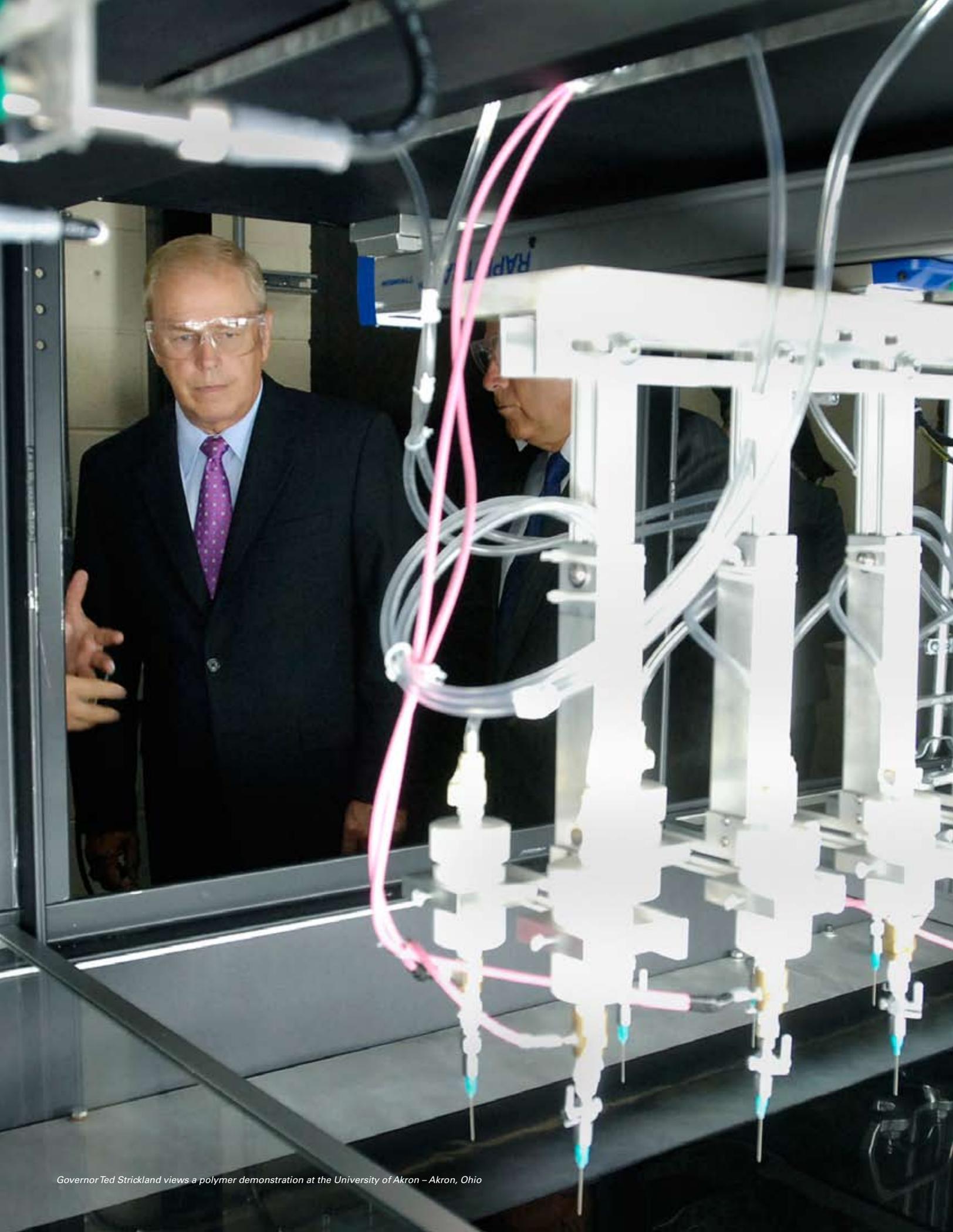


Ted Strickland, Governor  
Lee Fisher, Lt. Governor

## Third Frontier

Innovation Creating Opportunity

Mark Barbash, Interim Director  
Ohio Department of Development



*Governor Ted Strickland views a polymer demonstration at the University of Akron – Akron, Ohio*



# Department of Development

**Ted Strickland**, Governor  
**Lee Fisher**, Lt. Governor

**Mark Barbash**, Interim Director

**March 2009**

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## Ted Strickland, Governor, State of Ohio General Assembly, State of Ohio

Dear Colleague,

I am pleased to present to you the 2008 Ohio Third Frontier Annual Report. It has been another remarkable year, with Ohio once again demonstrating its national leadership in the support of technology-based economic development. This report is a welcome opportunity to tell you how a visionary and bipartisan commitment to Ohio's future prosperity made in 2002 is paying substantial dividends even in these challenging times.

In 2008, Ohio Third Frontier reached another high water mark attracting \$3.5 billion in additional resources to projects and companies. This represents nearly nine new dollars for every one dollar expensed by the Ohio Third Frontier suite of programs, and tripling the original projected program leverage ratio of three-to-one. To date, Ohio Third Frontier has assisted in the creation, attraction, or capitalization of more than 500 companies in our state, whose staff command an average salary of nearly \$68,000 per year. Several highlights stand out:

- The Ohio Third Frontier Advanced Energy Program was launched this year to proactively take advantage of the opportunities created by Ohio's landmark Energy Bill, signed into law in 2008 in response to growing global market demand for advanced and alternative energy products and services. The Advanced Energy Program encourages commercialization of solar, wind, bio-fuels, energy storage and energy efficiency products, and complements our already highly successful Ohio Third Frontier Fuel Cell Program. To date, \$12 million in grants to 17 entities have been awarded to accelerate the development and growth of the advanced energy industry in the State of Ohio.
- Unprecedented collaboration and investment by the Ohio Department of Development and the Ohio Board of Regents is attracting world-class researchers through the Ohio Research Scholars Program. This collaboration solidifies our commitment to bringing the best and brightest talent to Ohio – fueling cutting-edge research to realize our long-term economic development goals. To date, the Ohio Research Scholars Program has awarded \$143 million to attract 26 scholars that will contribute to the growth of scientifically and commercially relevant clusters of research excellence.
- The Entrepreneurial Signature Program took root at the six regionally located networking organizations that assist in the provision of investment capital and associated services to dozens of technology based start-ups throughout Ohio. The Entrepreneurial Signature Program, launched in fiscal year 2007 with more than \$120 million in Ohio Third Frontier grants and associated cost share, is fostering a vigorous entrepreneurial climate throughout Ohio.

We are proud of the accomplishments represented in this report and are committed to making continuous improvements that will keep this initiative vibrant and relevant in a fast-changing economic climate. The Ohio Third Frontier is innovation creating opportunity.

Sincerely,

**Mark Barbash**  
Chair, Ohio Third Frontier Commission  
Interim Director, Ohio Department of Development

77 South High Street  
P.O. Box 1001  
Columbus, Ohio 43216-1001 U.S.A.  
614 | 466 2480  
800 | 848 1300  
www.development.ohio.gov

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## Ohio Third Frontier

The OhioThird Frontier represents an unprecedented and bipartisan commitment to expand Ohio's technological strengths and promote commercialization that leads to economic prosperity throughout Ohio. Designed to build world-class research programs, nurture early stage companies, and foster technology development that makes existing industries more productive, OhioThird Frontier creates opportunity through innovation.



Governor Ted Strickland visits American Trim – Lima, Ohio

*“Ohio’s \$1.6 billion Third Frontier initiative is a comprehensive, professionally-run effort to build world-class research capacity, promote interaction between research and industry, and commercialize R&D.”*

– National Governor’s Association and  
Pew Center for the States

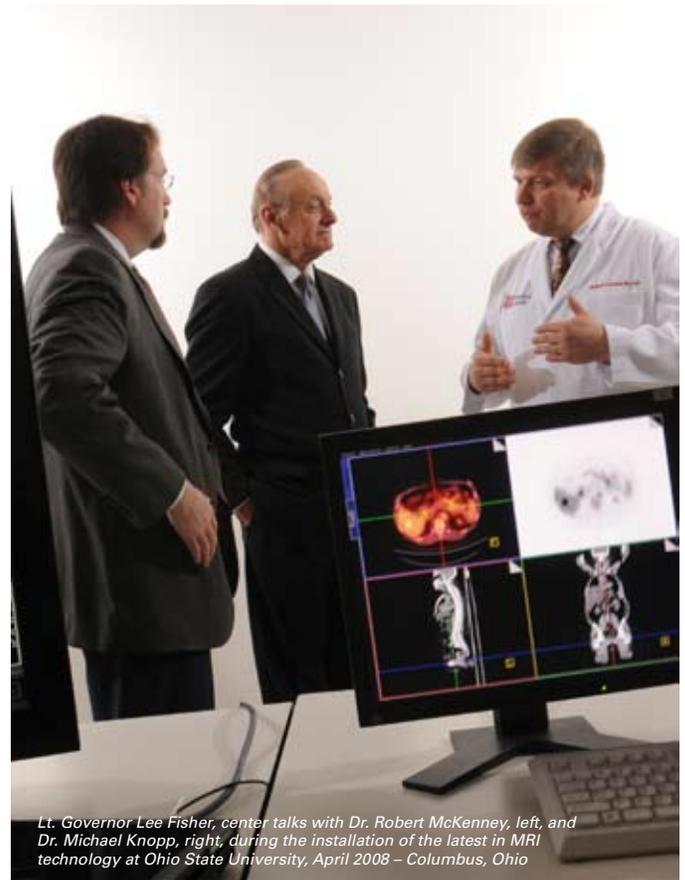
OhioThird Frontier targets its investments to support technology areas that represent Ohio’s key competitive opportunities:

- Advanced and Alternative Energy
- Biomedical
- Advanced Materials
- Instruments-Controls-Electronics
- Advanced Propulsion

OhioThird Frontier catalyzes targeted growth in existing and emerging industry clusters by:

- Increasing the quantity of high quality, commercially relevant research that accelerates growth for Ohio companies
- Expanding access and availability of investment capital to create, grow and attract technology-based enterprises
- Growing and nurturing an increasingly experienced pool of entrepreneurial management talent capable of turning an idea into a company
- Addressing the technical needs of existing companies pursuing new products and production processes
- Contributing to the expansion of a technologically proficient workforce.

With a comprehensive strategy and a focus on our strengths, OhioThird Frontier is helping to create the industries and jobs that are shaping Ohio’s economic future.



Lt. Governor Lee Fisher, center talks with Dr. Robert McKenney, left, and Dr. Michael Knopp, right, during the installation of the latest in MRI technology at Ohio State University, April 2008 – Columbus, Ohio

# Product Innovation



## Ohio Manufacturers' Innovative Spirit Alive and Well

In the "Flat World" described by Thomas Freidman, complacency is fatal; companies that find synergies with evolving markets discover new successes through an ability to adapt. This ability to adapt is, and will continue to be, a key competitive advantage in the 21<sup>st</sup> Century global economy. Ohio's ability to compete globally stems from our rich tradition of innovation which is evidenced today by our manufacturers' pursuit of new product innovations for non-traditional markets. The Ohio Third Frontier fosters this spirit of innovation by helping to address the technical needs of existing companies willing to refocus their robust strengths to create new products, industries, markets, and jobs. This innovative spirit is exemplified by the following three Ohio companies.



In 1945, **Crown Equipment Corporation** started manufacturing temperature controls for coal-burning furnaces. Its adaptive history then led the company to manufacture television antenna rotators at its facility in New Bremen, Ohio. Since 1956, **Crown** has designed,

manufactured, distributed, serviced and supported material handling products, providing lift trucks to an array of industries.

Today, **Crown's** heavy-duty lift trucks are used in a variety of applications, such as transporting goods through the narrow aisles of warehouses, distribution centers and manufacturing facilities. In an effort to further enhance efficiency in warehousing operations, Crown has been developing a fuel cell application for its warehouse lift trucks. If successful, the technology will replace batteries in warehouse vehicles, saving both resources and time.

Ohio Third Frontier funding has enabled **Crown** to accelerate its research, placing the company at the leading edge of the deployment of cost effective fuel cell technology for the lift truck market. In mid-2008, **Crown** established a dedicated test center to qualify lift trucks for commercially available fuel cells. Customer interest remains high. Five fuel cells from three different suppliers have been evaluated for all three classes of lift truck, and **Crown** is currently field testing a U.S. Department of Defense application.

Created in 1948 as Lima Tool & Die, **American Trim** was once a start-up with four employees manufacturing appliance handles for kitchen ranges. Today, the company has expanded into the areas of electromagnetic forming, physical vapor deposition,

### Markets Served by American Trim

- Automotive
- Building Products
- Furniture
- Marine
- Appliance
- Fuel Cell
- Heavy Truck
- Motorcycle

## Product Innovation

digital printing and advanced surface modification to achieve a global presence with 1,500 employees and annual sales of \$250 million.

With Ohio Third Frontier funding, and in collaboration with Lima's Rhodes State College, **American Trim** is playing a leading role in the Advanced Materials Commercialization Center and the Advanced Materials Deposition Center. Specifically, **American Trim** has opened its Lima facility to house these centers, while Rhodes State College provides the equipment to develop and commercialize these advanced product process methods. As a result of this collaboration, **American Trim** has developed a cost-effective and environmentally acceptable near-chrome finishing process which is eliminating the need to send products off-shore for chroming, reducing production cycle time, and enabling the company to retain jobs in Ohio.

Furthermore, the Ohio Third Frontier investment is contributing to student education and workforce development at the undergraduate and graduate level at Rhodes State College and Ohio Northern University, training engineering students and technicians in cutting-edge processes thereby ensuring that Ohioans have the ability to upgrade their skill sets to prepare for these jobs.

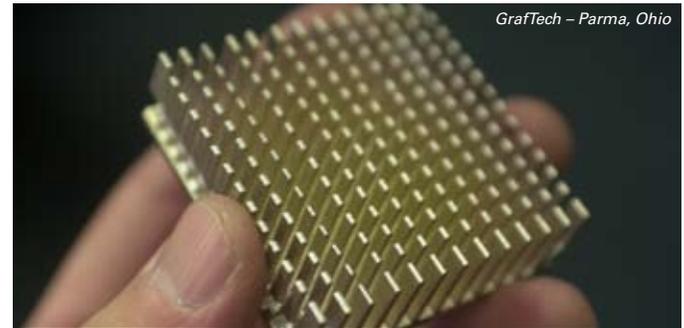
With a 120-year history in Ohio, **GrafTech**, located in Parma, has always been a leading innovator, producing the arc carbons that allowed the city of Cleveland to become the first in the world to have electric street lamps and enabling the lighting necessary for early color motion picture photography. The Ohio Third Frontier has provided R&D funding to help **GrafTech** continue to build on its innovative past with new products and market opportunities.

In recent years, **GrafTech** has revolutionized the consumer electronics world by introducing electronic thermal management solutions that enable lighter and thinner plasma television sets, laptop computers, and cell phones. Funding from the Ohio Third Frontier has supported advanced materials research that will enable **GrafTech** to develop the next-generation graphite sheet with enhanced properties at a lower cost to meet consumer product demand in the future.

With Ohio Third Frontier support, **GrafTech** has also pioneered the use of lightweight, corrosion-resistant graphite-based materials used in critical components of fuel cells. These novel materials are now found in fuel cells for hydrogen-powered automobiles, buses, fork-lift trucks and backup power applications. The company

foresees future applications in consumer electronics and stationary power.

The Ohio Third Frontier delivers assistance to Ohio manufacturing companies that sustain Ohio's global competitive advantages for product development, company growth and attraction, job creation and wealth creation. By assisting Ohio manufacturing companies to explore new opportunities and collaborations, companies are finding synergies with evolving markets and discovering new economic successes by adapting to technological and market forces.



GrafTech - Parma, Ohio

### GrafTech Awards

- With a \$2.9 million **U.S. Department of Energy** grant, **GrafTech** is developing next-generation bipolar plates for automotive polymer electrolyte membrane fuel cells.
- Initial funding from the **Ohio Third Frontier** led to the award of a \$1.6 million **U.S. Air Force** appropriation to develop conductive graphite foam for aerospace heat exchangers in a collaboration between **GrafTech**, the **Ohio Aerospace Institute**, and **Ohio University**.
- In 2005, **GrafTech** won the **Frost & Sullivan Award for Excellence in Technology**.
- **GrafTech** won the **2006 State of Ohio Governor's Excellence in Exporting Award** due to expanded thermal management solution sales in Asia.
- **eGRAF®** thermal management products have won two **Research & Development 100** awards (2003 & 2004); **GRAFCELL®** bipolar plates took the award in 2007.
- **GrafTech's CEO, Craig Shular**, won the **2008 Ernst & Young Entrepreneur of the Year Award** for his company's financial successes in supporting innovation.
- **GrafTech** has maintained a continual presence in the Cleveland area since the 1880's.

# Capital Access for Biomedical



The Ohio State University  
Columbus, Ohio

## Growing Capital Access for Biomedical Firms

Entrepreneurial activity thrives where there is an abundance of capital – Silicon Valley, San Diego, and Boston provide strong case studies to this point. Beyond a handful of notable examples, the nation is not awash in capital for start-up enterprises. Ohio is on a deliberate path to become one of the notable places with sufficient investment capital to support the creation and growth of technology-based companies, especially in the technology fields that are the focus of the Ohio Third Frontier.

One such field is biomedical, and we have recent evidence of progress toward our goal related to the availability of investment capital. Ohio recently ranked second in the Midwest for dollars attracted for healthcare start-ups by the *Midwest Health Care Venture Report 2008*, assembled by the Mid-America Healthcare Investors Network and BioEnterprise. This ranking is a direct result of the number of biomedical companies receiving the investment capital that enables them to grow and succeed in Ohio.



One such company is **Minimally Invasive Devices**. Wayne Poll is a Columbus physician who has first-hand knowledge of the limitations of medical devices used in laparoscopic surgery. To overcome these limitations, he formed **Minimally Invasive Devices** in 2006

to develop and market new medical instruments, including a disposable device to clean and defog laparoscopic surgical tools while they are being used during surgery. The early-stage medical enterprise has received \$2.4 million in angel capital, a portion of which came from funds supported by the OhioThird Frontier.

There are many other examples like **Minimally Invasive Devices** where the robust ecosystem that the OhioThird Frontier is helping create has supported technology start-ups in Ohio with world-class research, entrepreneurial business services, a growing pool of talent, and a pipeline of capital to take those companies from creation to market entry.



Cincinnati-based **AssureRx** is a personalized medicine company dedicated to helping physicians determine the right drug at the right dose for individual patients suffering from a range of medical conditions. The company was founded in 2006 to license and commercialize personalized medicine technology discovered at **Cincinnati Children's Hospital Medical Center**. **AssureRx's** creation would not have been possible without the entrepreneurial services and \$3 million in local seed capital received from OhioThird Frontier-supported resources.

## Growing Capital Access for Biomedical Firms

**Arterioocyte Medical Systems, Inc.** began life as a start-up biomedical company with products based on stem-cell therapies developed by the OhioThird Frontier-funded Center For Stem Cell and Regenerative Medicine in Cleveland. To move these technologies through preclinical and clinical trials, **Arterioocyte** raised \$3.8 million in seed funding and development grants, including significant direct support from the OhioThird Frontier. This early investment put **Arterioocyte** on a rapid growth curve. In 2008, the company attracted a \$10 million growth capital investment from outside of Ohio, enabling the company to market novel stem cell products to improve patient outcomes in cardiac, orthopedic and vascular surgeries.

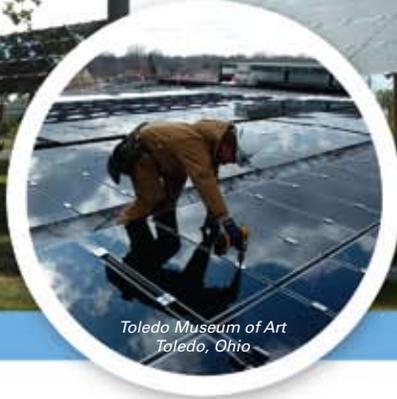


The goal of investment capital and entrepreneurial services to Ohio's small biotech companies is to position them for major growth and job creation. **HTP, Inc.**, a healthcare information company in Columbus is a prime example. **HTP** received entrepreneurial assistance from an Edison Incubator and capital from an Edison Center and OhioThird Frontier-supported angel capital fund totaling \$2.5 million. As a result of **HTP's** early success, the company was recently purchased by health giant **McKesson Medical-Surgical** for what was likely a multi-million dollar deal (purchase details not disclosed publicly). This strategic partnership provides a major growth path for **HTP** and its current 65 employees in Columbus.

While the spotlight of this article is on biomedical companies, the investments made by the OhioThird Frontier in entrepreneurial assistance and early-stage capital have put Ohio on the path to similar success in other industries important to our state's future including advanced energy and materials. Capital is the life-blood of commerce, and being a leader in the formation and attraction of capital makes Ohio a desirable final destination for the growth of new companies and new industries that will shape and change Ohio's future economy.



## Solar and Photovoltaic



Toledo Museum of Art  
Toledo, Ohio

University of Toledo – Toledo, Ohio

### Toledo: A Solar Hotspot

The Economist, The Wall Street Journal, Newsweek, and investors around the world recognize Toledo as a hotspot for research, development, and commercialization of advanced solar technologies. The Regional Growth Partnership in Toledo estimates that more than 5,000 jobs in solar energy have been created in the Toledo area over the last five years. Stemming from its history of glass making, Toledo has leveraged academic successes at the **University of Toledo**, industry leadership successes at **First Solar**, entrepreneurial successes at **Xunlight**, and significant support from the Ohio Third Frontier to become the home of a dynamic cluster of people, companies and products focused on solar photovoltaics – technology that directly converts sunlight into electricity.

Ohio's Third Frontier has invested more than \$33 million into the photovoltaic cluster in Northwest Ohio. Through investments in the **Photovoltaics Innovation Center** – a **Wright Center of Innovation**, in one **Ohio Research Scholar**, and in direct grants to small companies, the Ohio Third Frontier has stimulated the growth of an industrial cluster that symbolizes how historic Ohio strengths can be converted into new, innovative, and successful opportunities for economic growth.

Ohio's photovoltaics expertise has surprised some in the public and investment communities, but its origins trace back to companies such as **Owens-Corning**, **Owens-Illinois**, **Libbey Glass**, **Pilkington**, **Glasstech**, **Tempglass**, and **Therma-Tru** and to Ohio's overall expertise in advanced materials, chemistry, and material coating. As the glass industry began to decline in the 1980s, two relatively small investments by the **State of Ohio's Thomas Edison Program** to the **University of Toledo** and two industrial partners,

**Solar Cells, Inc.** and **Glasstech, Inc.**, were made for the purposes of investigating the potential of photovoltaic manufacturing. These investments led to strong partnerships between the University and industry in their region. Today, Solar Cells, Inc. has become **First Solar** and is now the world's largest manufacturer of solar photovoltaic panels.



Technology never stands still. The **University of Toledo** and local companies, with the help of the Ohio Third Frontier, are continuously making investments in areas which will advance the photovoltaic industry. Improvements in the efficiency of sunlight conversion to electricity, creation of photovoltaic cells on flexible materials, and more efficient manufacturing methods are all being researched. World experts in these fields have come to the University and Northwest Ohio. With them have come new ideas and entrepreneurial opportunities. An example of the potential for new companies, employment and new wealth creation is **Xunlight**, a company started by a **University of Toledo** faculty member. **Xunlight** is perfecting how to produce thin film photovoltaic panels on flexible substrates and then manufacture these new panels in a continuous process. The company has received more than \$40 million in private investment capital from some of the most knowledgeable investors in the world. In addition

## Solar and Photovoltaic

to Xunlight, other photovoltaic companies are receiving entrepreneurial assistance from the Ohio Third Frontier and Edison-funded organizations in the region.



Dr. Xunming Deng, Founder of Xunlight Corporation – Toledo, Ohio

Advances in technology must be delivered to the marketplace for Ohio to fully realize the potential for job growth. The Ohio Third Frontier has made investments in companies that are working to develop new and more cost-effective ways to install the solar photovoltaic panels. **The Garland Company** and **Xunlight 26** have both been funded to develop actual technology to install the new photovoltaic panels on commercial, residential, and industrial buildings.

The investments in photovoltaics by the Ohio Third Frontier also fit strategically into other state policy and programs. House Bill 221 calls for an alternative energy portfolio standard for electricity production in Ohio. Photovoltaics are one manner of achieving the requirements. House Bill 554 established an Advanced Energy Job Stimulus program, and photovoltaics is a technology that can offer short-term job creation potential in Ohio. Finally, as part of the federal stimulus package, advanced energy and photovoltaics play a prominent role in the future of our nation.

The Ohio Third Frontier, in coordination with other important state and federal programmatic directives, is helping to ensure that Ohio's economy is able to capitalize on the emergence of new dynamic industrial clusters, such as the solar photovoltaics cluster in Northwest Ohio. Through the development of these industrial clusters, Ohio will be able to leverage its historical strengths into new opportunities for product development which in turn leads to company, job, and wealth creation.

### Ohio Third Frontier: *Building Partnerships – Solar & Photovoltaic*

Over the past five years the photovoltaic (PV) group at the University of Toledo has been among the top three in the nation, along with the University of Delaware and Georgia Tech. Within the last two years significant progress has occurred that places the University of Toledo and Northwest Ohio in the leadership position for photovoltaic research, development, and commercialization:

- The Photovoltaic Innovation Center, formed with an \$18.6 million grant from the Ohio Third Frontier, supports the development of new advanced laboratory space and facilities, providing a framework for industry collaboration within Ohio.
- PVIC is a consortium of academic, for-profit and non-profit partners including **The Ohio State University, Bowling Green State University, Owens Corning, Decker Homes, NewCyte, Inc., McMaster Energy Systems, Battelle, Innovative Thin Films LLC, Xunlight, MetaMateria Partners, LLC, Green Energy Ohio, Pilkington North America, Advanced Distributed Generation, LLC.**
- The attraction of two world-recognized photovoltaic scientists from the US Department of Energy's National Renewable Energy Laboratory to the University of Toledo.
- The expansion of US Air Force funding to the University of Toledo from approximately \$1 million to \$3 million annually, as well as the award of a \$1 million NASA grant to establish a photovoltaic test facility at the University of Toledo.
- The award of two US Department of Energy contracts to the University of Toledo in the University Photovoltaic Product & Process Development Program of the Solar America Initiative, among only 11 awards nationwide, for a total of \$2.5 million over three years.
- The award of an \$8 million Ohio Research Scholars Program grant and a McMaster family donation of \$2 million to support the attraction of four new photovoltaic faculty members including two new endowed chairs.
- The development of educational programs from installation training, Bachelors of Science & Engineering, and doctorate programs in photovoltaics at Owens Community College, the University of Toledo, and The Ohio State University respectively.
- The receipt by Xunlight of \$40 million in venture capital funding from Emerald Technology Ventures, Trident Capital, and Rabo Ventures over three separate rounds of funding.
- The award from the Ohio Third Frontier of \$1 million to the Garland Company, with the University of Toledo as a collaborator, and \$996,000 to Xunlight 26, in support of the development of rooftop solar systems.
- The award from the Ohio Third Frontier of \$4.97 million to Xunlight in support of new photovoltaic fabrication and manufacturing technologies.

# Liquid Crystal Technology



AlphaMicron – Kent, Ohio

## Northeast Ohio Capitalizing on Unique Liquid Crystal Niche

OhioThird Frontier is strengthening existing and emerging technology clusters across Ohio by providing key resources to help make our state’s regional economies even more globally competitive. In Northeast Ohio, university and industrial collaborators have partnered with the OhioThird Frontier to establish the region as a global leader in liquid crystal technologies.

Currently, most of the world’s liquid crystal manufacturing, especially for large panel displays and monitors, occurs in the Asia-Pacific Rim. With assistance from OhioThird Frontier, **Kent Displays**, **AlphaMicron**, **Kent State University** and the **Northeast Ohio Universities College of Medicine and Pharmacy (NEOUCOM)** are conducting research to drive liquid crystal research and development, commercialization and manufacturing efforts. Rather than target display product markets already dominated by Asian manufacturers, these Northeast Ohio companies and institutions are focusing on niche-market product applications, including watches, electronic message boards and next-generation writing tablets, as well as other applications.

The **Liquid Crystal Institute** at **Kent State University** has grown into an invaluable asset for Ohio’s liquid crystal research and development capabilities. The institute is a key catalyst for technology commercialization, spawning companies and jobs for Ohioans, and has developed a reputation as a global leader in liquid crystal technology. Created in 1965, the **Liquid Crystal Institute** has become home to world-class researchers

and scientists, has attracted millions of dollars in Federal, State and other funding support, and is responsible for numerous discoveries and patents. Ohio Third Frontier funding has supported the replacement of conventional rigid liquid crystal display substrates with flexible plastic, as well as the replacement of expensive batch manufacturing with more efficient and cost-effective roll-to-roll processing.

**Kent Displays**, founded in 1993, and **AlphaMicron**, founded in 1997, are two successful spin-outs from the Liquid Crystal Institute at Kent State. The two companies now employ 56 and 35 individuals, respectively. The close proximity to the institute and the university benefit both companies significantly. Their focus on different markets, common manufacturing methods, and research interests has allowed them to utilize distinct synergies by forming a manufacturing alliance supported by common supply chain elements and sources of intellectual capital, including **Akron Polymer Systems**, the **University of Akron**, and **Kent State**.



Kent Displays – Kent, Ohio

## Liquid Crystal Technologies

In September 2008, **Kent Displays**, through funding from the Ohio Third Frontier, installed a roll-to-roll production line to enable the manufacturing of its Reflex™ flexible displays technology. The first of its kind in the world, the production line enables **Kent Displays** to produce vast quantities of its flexible LCDs rapidly and efficiently. Production will eventually be operated by multiple work shifts and will increase the supply of flexible, low-power displays for product applications such as credit cards, product tags and other ePaper applications. **Kent Displays** has also ventured into next-generation writing tablets – offered in late 2008 and targeted towards teens and the back-to-school markets.

Adaptive Windows – containing self-regulating and electronically powered controllable tint – are being developed by **AlphaMicron** as a result of Ohio Third Frontier funding. The windows use **AlphaMicron's** liquid crystal technology, VALiD, to create an adaptive film that can be laminated to windows, assisting with the heating and cooling of buildings and increasing energy efficiency. **AlphaMicron's** technology is already being utilized in digital lenses for ski goggles, racing helmets, auto dimming mirrors in cars and motorcycles, fashion clothing, and the company's Tician line of eyewear.

AlphaMicron – Kent, Ohio



**Kent State University** and the **Northeast Ohio Universities College of Medicine and Pharmacy (NEOUCOM)**, in collaboration with **Pathogen Systems**, is further developing liquid crystal technology for pathogens detection. With support from the Ohio Third Frontier, this partnership focuses on the commercialization of a platform technology for a microbial pathogen monitoring system. The instrument can simultaneously detect and identify pathogens that could have adverse human health effects. This partnership will create a research lab as well as a manufacturing facility, which are expected to launch by 2010.



Furthermore, the region is working to leverage two of its strong industrial clusters to make them both more globally competitive. A partnership within **Kent State's Centennial Research Park** known as the **FLEXMatters Accelerator** is capitalizing on two Northeast Ohio strengths – liquid crystal research at **Kent State** and polymers research at the **University of Akron**. The Accelerator is combining Northeast Ohio universities' research and development strengths with the commercialization capabilities of regional companies to support existing jobs as well as create and grow new start-ups.

By combining a strong skilled workforce, world-class research, and commercialization efforts, Ohio Third Frontier is helping Northeast Ohio capitalize on its position as a leader in the liquid crystals industry.

### Niche-Market Products for Liquid Crystal Technologies

- watches
- electronic message boards
- next generation writing tablets
- miniature security screens on credit cards
- electronic skin displays for mobile phones
- digital lighting control for lenses in ski goggles and eyewear
- auto dimming mirrors for the automotive and motorcycle industries
- energy efficient auto adjusting windows
- a detection and monitoring instrument for microbial pathogens

# Research and Technology



## To the World's Research Talent – Welcome to Ohio!

Welcome to Professor Hiroshi Yokoyama and his family, the first distinguished scientist attracted to Ohio having the title Ohio Research Scholar. Professor Yokoyama will be supported with one of the 26 endowments funded as a result of an unprecedented \$143 million investment made by the Ohio Third Frontier and the Chancellor of the Board of Regents, through the legislatively created Ohio Research Scholars Program.



Yokoyama has been named Professor of Chemical Physics at the **Liquid Crystal Institute** of **Kent State University**. He most recently held the position of director of the **Nanotechnology Research Institute** at the **National Institute of Advanced Industrial Science and Technology**, an amalgamation of 15 institutes representing Japan's largest public research organization. Professor Yokoyama is a world expert



in the field of liquid crystal physics. His expertise will contribute to the expanding knowledge base that is propelling the growth of the liquid crystal industry in Northeast Ohio, represented by companies such as **Kent Displays** and **Alpha-Micron**.

Innovation and economic prosperity often flourish where there are centers of great science and research, and world-class talent is most often the common denominator that determines success. Competition for talent is global, and Ohio must be prepared to aggressively compete. The Ohio Research Scholars Program is a resounding declarative that we are globally competitive. Offering endowment funding, capital for laboratories and equipment, and operating funds, the goal is to build upon existing strengths within our academic research institutions to create and grow industry relevant and supported centers of research excellence.

With the funding provided by the Ohio Research Scholars Program in FY 2008, nine collaborative projects involving Ohio's leading public and private research universities, medical centers and a host of business partners will be aggressively recruiting 25 more distinguished scientists and engineers like Professor Yokoyama. These talented people will become part of research and commercialization teams across Ohio that can spawn new innovations, products and companies. And they will do so in areas that represent the future of Ohio's economic growth including biomedical, alternative energy, and advanced materials.

With the Ohio Research Scholars Program, we have put the welcome mat out for the world's best and brightest.

## Education, Collaboration, Innovation

Lead Institution	Academic Collaborators	# of Scholars	Technology Focus
Kent State University	Case Western Reserve University	3	Advanced Materials-Soft Matter Interfaces
The Ohio State University	University of Akron, University of Dayton	4	Emergent Materials-Predictive Modeling and Characterization
The Ohio State University	Case Western Reserve University, Ohio University, University of Toledo	2	Advanced Energy Systems
The Ohio State University	Case Western Reserve University, Wright State University	5	Biomedical Imaging
University of Akron	Northeastern Ohio Universities College of Medicine	2	Orthopaedics
University of Cincinnati	The Ohio State University, University of Dayton	5	Aero-propulsion
University of Dayton	The Ohio State University, Miami University, Wright State University	3	Layered Sensing
University of Toledo	Cleveland Clinic Foundation	1	Spinal Implants
University of Toledo	Bowling Green State University	1	Thin Film Photovoltaics



## Cardiovascular and Regenerative Medicine



The Cleveland Clinic  
Cleveland, Ohio

### Mending Broken Hearts

Heart disease is the single greatest cause of death among Americans. Each year, an estimated 1.2 million Americans have a new or recurrent coronary attack or succumb to fatal coronary heart disease. In addition to the tremendous personal cost, coronary heart disease is an enormous economic burden on the U.S. healthcare system, with an estimated direct and indirect cost of \$151.6 billion in 2007. The Ohio Third Frontier, building on world-class technology and expertise in Ohio, has invested in several complementary and collaborative approaches to help solve this tremendous healthcare problem.

The **Cleveland Clinic** is recognized as a world leader in cardiovascular medicine, consistently chosen as the top-ranked program by *US News & World Report*. Leveraging this expertise, the Ohio Third Frontier has partnered with the **Cleveland Clinic** to support, create and attract new cardiovascular focused companies through investments in the **Atrial Fibrillation Innovation Center** and the **Global Cardiovascular Innovation Center**. The two Centers have recently merged, combining assets and strengths to represent an international powerhouse of research, clinical medicine, and commercialization related to cardiovascular therapies. Together they are the Ohio Third Frontier's largest single investment to date.

The **Cleveland Clinic's** combined effort, now represented as the **Global Cardiovascular Innovation Center**, is supporting innovative cardiovascular-focused companies through research investments, collaborations with clinical scientists, and incubation support. Backed by the reputation and expertise of the **Cleveland Clinic**, the **Global Cardiovascular Innovation Center** has been successful in creating,

investing in and attracting 35 companies. These new Ohio companies' technologies include medical devices, cell-based therapies, and imaging technology that contribute to cardiovascular health. Further, the **Global Cardiovascular Innovation Center**, in collaboration with an urban development group dedicated to upgrading the Fairfax neighborhood of Cleveland, has recently broken ground on a new 50,000 square-foot incubator facility near the **Cleveland Clinic** to further expand and support companies created and attracted.

The Cleveland Clinic – Cleveland, Ohio



A complementary approach to cardiovascular healthcare is being pursued just down the street by the **Center for Stem Cell and Regenerative Medicine** established in 2003 at **Case Western Reserve University** through an investment by the Ohio Third Frontier. The **Center for Stem Cell and Regenerative Medicine's** mission is to restore health through the use of stem cells and regenerative medicine. Cardiovascular disease is one of the Center for Stem Cell and Regenerative Medicine's successful focus areas. The Center has

## Cardiovascular and Regenerative Medicine

spun out two companies to date – **Arteriocyte Medical Systems** and **AcelleRX Therapeutics** – along with other industrial partnerships, including **Athersys**. These companies are focused on the potential of stem cells to restore function to tissue damaged by a heart attack. Therapies that have been developed through the **Center for Stem Cell and Regenerative Medicine** and its associated companies have moved into clinical trials in humans, a significant step along the pathway to U.S. Food and Drug Administration (FDA) acceptance of a new treatment.



*Athersys, Inc. – Cleveland, Ohio*

The awards in cardiovascular and regenerative medicine complement each other by supporting a broad-based set of technologies to address the problem of heart disease. Their collaborative efforts have resulted in joint research, development, and commercialization projects at numerous Ohio research institutions and biomedical companies that are capturing the attention of venture capital funds to continue the technical advances needed to commercialize cardiovascular products and services. As a result, a true cluster of economic activity focused on curing heart disease has been anchored in Ohio.

### Commercialization Summaries:

**Arteriocyte Medical Systems, Inc.** is a clinical stage biotechnology company that engineers stem cell and tissue-based therapies with the goal of developing commercially available stem cell therapies. Although patients with chronic coronary heart disease are offered a number of treatment choices, a significant portion of the affected patient population is unable to withstand surgical intervention. Often referred to as “no-option” cases, these patients are the initial targets for **Arteriocyte’s** cell therapy product – an infusion of cultured stem cells into the heart to stimulate blood flow.

**AcelleRX Therapeutics, Inc.** is in the development stages of regenerative medicine technologies for treatment of cardiovascular disease. Discovered by **Cleveland Clinic** cardiologist Marc Penn, the company’s product, Stromal Derived Factor – 1, significantly increases cardiac function through promoting cell survival and revascularization after a heart attack, significantly enhancing the efficacy of a broad range of clinical trial stage cell therapies.

**Athersys, Inc.’s** proprietary MultiStem® system is a biologic product that consists of stem cells used in the treatment of acute heart attacks, potentially eliminating the need for immunosuppressive drugs to damaged cardiac tissue. Obtained from adult bone marrow or other non-embryonic tissue sources, the cells may be produced on a large scale for future clinical use and stored in frozen form until needed.

# Internship Program



## Bright Minds, Bright Futures in Ohio

*“The **Ohio Third Frontier Internship Program** is focused on keeping the best that Ohio has to offer in Ohio,” said Patrick Hood, President and CEO of **Cornerstone Research Group**. “It works for the students that participate as interns, for the companies that hire the interns, for the technical business environment in Ohio, and for the entire state.”*

**Cornerstone Research Group**, an engineering firm in Dayton, has sponsored more than 70 Ohio Third Frontier interns and hired a dozen as full-time employees. This is just one of many stories that have resulted from a program that has helped place more than 3,000 students in 700-plus companies throughout Ohio.

Cornerstone Research Group – Dayton, Ohio



The **Ohio Third Frontier Internship Program** is helping develop a pool of talented workers for Ohio’s businesses, creating enriching student work experiences in STEM (Science, Technology, Engineering, and Math) disciplines, and assisting those students in obtaining permanent full-time employment in Ohio

after graduation. This is facilitated by Development’s Workforce and Talent Division that provides both a matchmaking mechanism for businesses and students and direct reimbursement to businesses of 50 percent of the cost of the internship up to \$3,000, an invaluable resource for Ohio companies and students.

Glatfelter – Chillicothe, Ohio



Not long ago, a paper mill with more than a century-long history in Chillicothe was acquired by **Glatfelter**, one of the world’s leading manufacturers of specialty papers and engineered products. During the transition, the company routinely hired interns and in 2008 sponsored 19 Ohio Third Frontier interns from a variety of engineering disciplines including Chemical, Pulp and Paper Engineering. Ten of these interns matriculated into full-time employees of **Glatfelter**.

“In essence, (an internship) is a ‘job interview’ for the intern,” according to a Glatfelter representative. “We feel that the program is a terrific recruiting tool and a great investment for our company.”

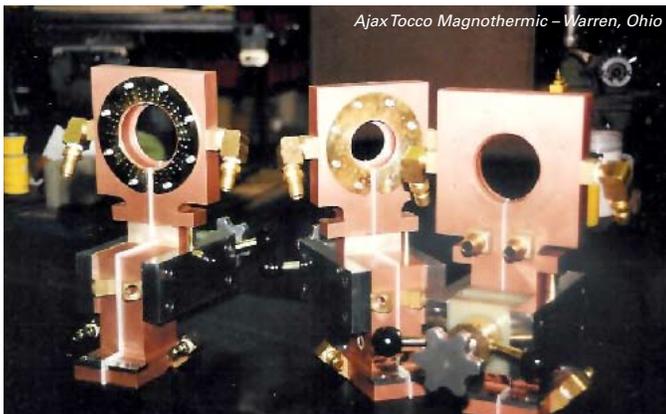
## Internship Program

**Yost Engineering** is a highly successful developer of healthcare and robotics products located in Portsmouth. The company has consistently achieved a growth rate of 15-20 percent annually. Yost has sponsored Ohio Third Frontier interns for the last three years, and has hired five as full-time developers with educational backgrounds in computer science and engineering.

*"As a small company, the relationship we build with students during their internships and the ability to leverage this relationship upon full-time hire is a key factor in our success," stated a spokesperson for Yost engineering. "Hands-on live product-line experience allows (Ohio Third Frontier Interns) to come on board at a much higher performance level than a typical new grad."*

**Ajax Tocco Magnethermic** in the City of Warren got a second chance after suffering through financial realignment troubles in 2002. Ajax Tocco was able to leverage the affordable high quality talent they attracted through the **Ohio Third Frontier Internship Program**. Over the last few years, Ajax Tocco has had a dozen interns that have worked in their Sales and Engineering and Research departments, many of whom were hired to full-time positions.

*"The matching money has been key in helping Ajax Tocco grow the company with new talent," said a representative from Ajax Tocco. "Because these students are all top of the class, they have been key contributors to its success."*



Ajax Tocco reports that it has been experiencing growth of 15 percent annually designing and manufacturing world-class heating and melting equipment.

While the value that Ohio companies receive by attracting affordable, highly skilled talent is significant, the work experience and career boost the interns themselves receive proves to be invaluable. Ohio Third Frontier interns get the chance to explore exciting career opportunities with companies here at home in Ohio.

Erik Kinor, a third-year engineering student at the University of Toledo, was an intern with **Dmytryka Jacobs Engineers** of Toledo. Kinor was hired by the firm after graduation.

*"I was able to learn what an Electrical Engineer does on a day-to-day basis by actually working with them and put some of the skills I already learned to use," Kinor said. "If it were not for the **Ohio Third Frontier Internship Program**, it would have been a lot more difficult for me to acquire a full-time position at an engineering firm right out of college."*

Matthew Hlavacek graduated Summa Cum Laude in Computer Information Sciences from Cleveland State University and into a full-time job with **Pointe Blank Solutions**, a software development company in Middleburg Heights. Matthew spent a year as an Ohio Third Frontier intern with Pointe Blank before being hired.

*"While learning in class gave me knowledge of development, logic, and advanced computer skills, it was through my internship at **Pointe Blank Solutions** that truly gave me the competitive edge in the workforce," said Hlavacek. "Most employers want to see real world skills when looking to hire someone, so an internship was a perfect opportunity to get 'on the job' experience."*

## FY 2008 Financial Information

**Total Expenditures:** \$177,230,394

**Sources:** Third Frontier Research and Development Fund; Wright Capital Fund; Biomedical Research and Technology Transfer Trust Fund; Third Frontier Action Fund

**Awards:**

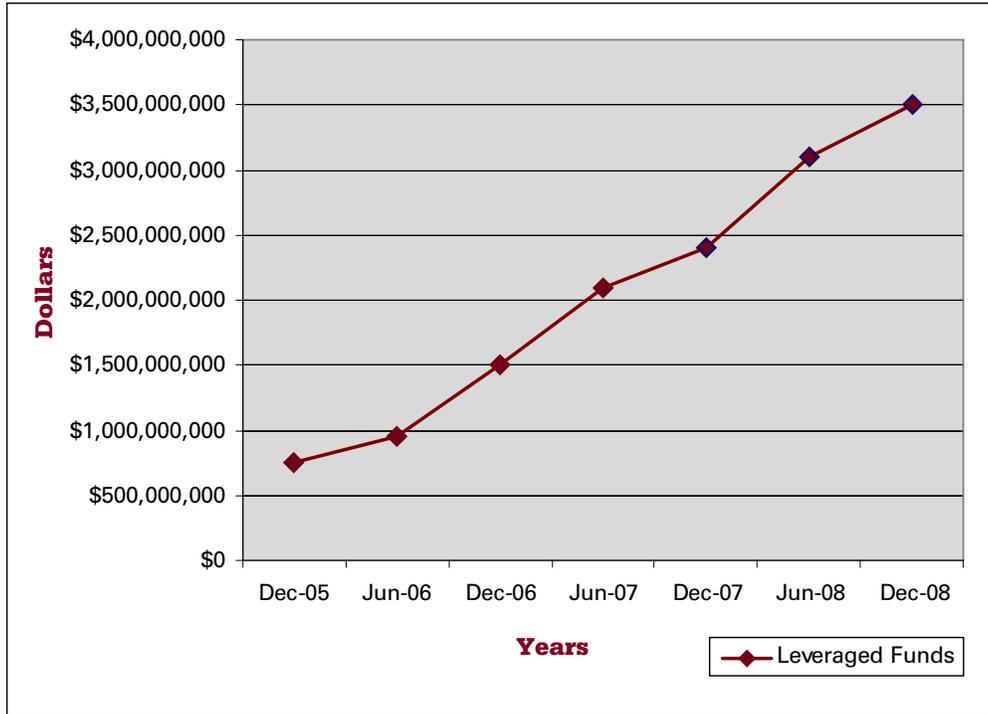
Program	Number of Awards	Amount (dollars)
Third Frontier Fuel Cell Program	12	\$8,820,520
Third Frontier Advanced Energy Program	17	\$12,037,236
Success and Pre-Seed Fund Initiative	7	\$8,500,000
Engineering & Physical Science Research and Commercialization Program	5	\$24,275,000
Biomedical Research and Commercialization Program	6	\$22,862,078
Wright Projects	7	\$22,479,248
Ohio Research Scholars Program	10	\$42,000,000
Ohio Research Commercialization Grant Program	8	\$2,789,580
Third Frontier Internship Program	*	\$1,500,000
Targeted Industry Attraction	2	\$1,250,000
Research Incentive	N/A	\$6,000,000
NextGen Network	N/A	\$20,000,000
Administrative Expenses	N/A	\$4,716,732
<b>Total Expenditures</b>		<b>\$177,230,394</b>

\* Twelve regionally-based organizations coordinate the deployment of internship funds at up to \$3,000 per position.

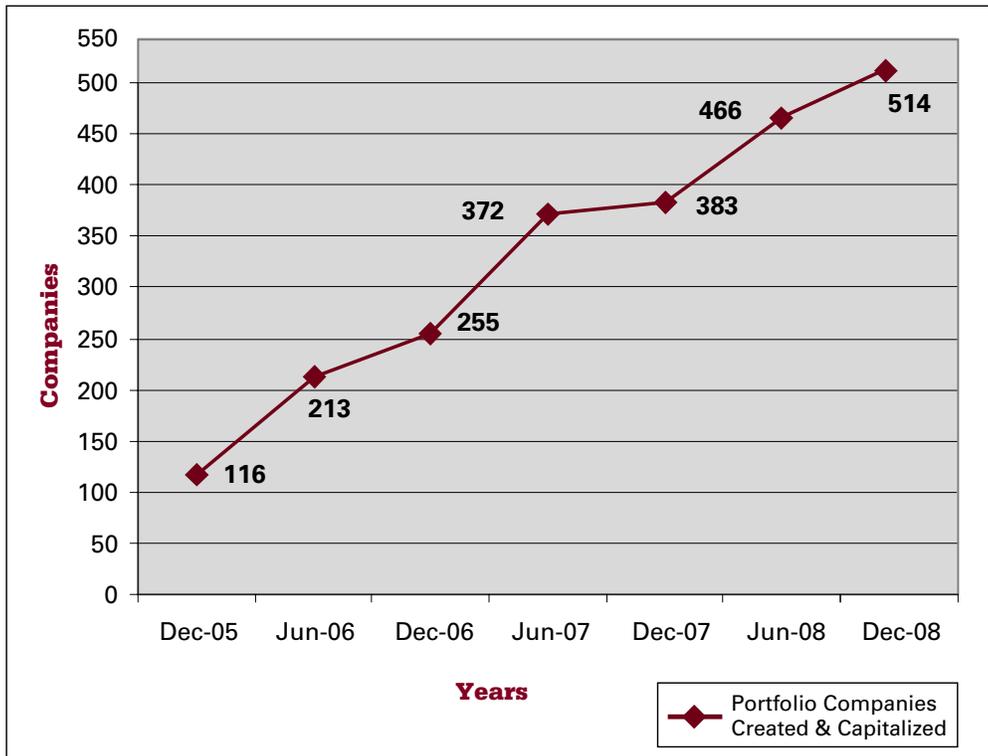
## Performance Metrics

Performance Criteria	As of 06/30/08	As of 12/31/08
<b>State Funds Awarded</b>	\$873,462,907	\$892,915,492
<b>State Funds Expended</b>	\$343,299,994	\$402,980,005
<b>Cost Share Reported</b>	\$891,522,131	\$912,882,262
<b>Leveraged Dollars</b>	\$3,075,785,242	\$3,517,236,062
<b>Leverage Ratio</b>	8.9 : 1	8.7 : 1
<b>Direct Jobs Created and Retained</b>	6,795	7,757
<b>Companies Created, Attracted, Capitalized</b>	466	514
<b>Average Salary</b>	\$64,237	\$67,654
<b>Cost Per Job</b>	\$50,520	\$51,951

## Funds Leveraged



## Companies Created/Capitalized







*Governor Ted Strickland and Lt. Governor Lee Fisher visit Amylin Pharmaceuticals – Cincinnati, Ohio*



**Department of  
Development**

**Ted Strickland**, Governor  
**Lee Fisher**, Lt. Governor

**Mark Barbash**, Interim Director

**800 | 848 1300**

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