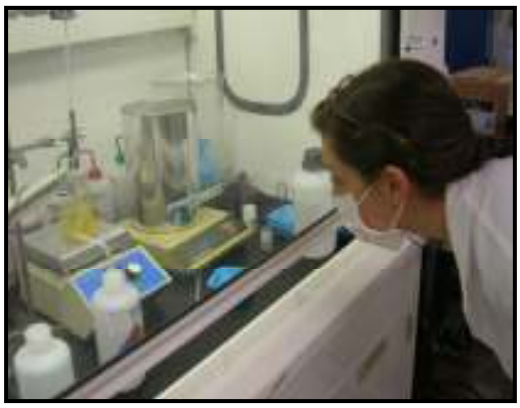
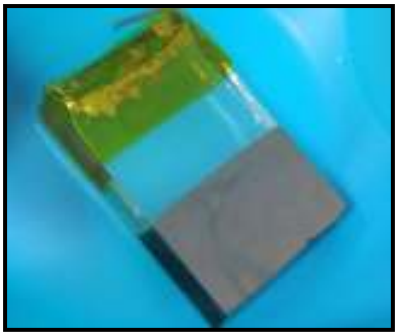
# Development of a Superlattice Solar Cell Prototype



***Impact:*** Existing solar electric technology is limited in performance to 15% to 20% efficient silicon solar cells and costs more than $4/watt. This technology is not very useful for power generation in buildings, where area is limited. The conceptual solar cell prototype to be developed under this funding will lead to higher performance and lower cost solar cell technology.

***Project Overview:*** This project aims to demonstrate a novel solar cell concept that has the potential for very high efficiency (>50%) and low cost (<$1/watt). Work will involve building a prototype of a superlattice solar cell device structure and characterizing its performance.



***GBA Product Innovation Grant Amount:*** $20,000

***Leadership:*** Dr. Pritpal Singh is Professor and Chairman of the Department of Electrical and Computer Engineering at Villanova University. Dr. Singh has been working on solar cell research for the last 25 years and has served as a consultant to the U.S. Department of Energy.

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**Awarded December 2007**

# Ductmate GreenSeam II Product Development

***Impact:*** Studies indicate that duct leakage in heating, ventilation, and air-conditioning (HVAC) systems is as much as 10 to 25% in commercial building systems and 15 to 25% in residential systems. This leakage has a significant effect on the energy consumed by commercial and residential buildings. As duct leakage can contribute to the potential for mold production in walls and other unconditioned spaces, duct leakage can also impact the health of the building and its occupants.

GreenSeam II will provide developers with the ability to significantly reduce duct leakage within the low pressure side of the HVAC system which will increase overall energy efficiency of commercial and residential buildings and reduce material use in the installation process. This product will be of value to HVAC ductwork companies, building designers, and developers and owners.

***Project Overview:*** The project team lead by Ductmate Industries is extending its research and development on leakage by reviewing how the unique manufacturing process and proprietary sealant used in the manufacturing of Ductmate's GreenSeam™ technology can be adapted to seal the transverse joints in self-sealing snap lock pipe. The University of Pittsburgh will provide assistance in identifying appropriate gasket materials, as well as testing and documentation of system performance. The project has the potential to reduce duct leakage from transverse connections of snap-lock pipe and fittings by as much as 95% without the use of traditional sealants.

***GBA Product Innovation Grant Amount:*** $100,000

***Leadership Team:*** The Ductmate Industries' leadership team includes Andrew Male, Manager of New Product Development, and Vince Bloom, Chemical Engineer of Ductmate Industries. The University partner is Dr. Patrick Smolinski, Associate Professor in the Department of Mechanical Engineering and Materials Science at the University of Pittsburgh. Ductmate is an industry leader in the manufacturing of commercial ductwork connections and ductwork accessories and its history and innovative design is well-documented through numerous patents which reduce duct leakage and improve overall duct system performance.

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**Awarded December 2007**

# GreenSim: A Process Simulator for Green Product Decision-Making

***Impact:*** While rapidly growing around the globe, the green building market can be a challenge to access if little is understood about the material and product selection process used by design teams. This lack of knowledge limits market access, increases sales costs, and undermines the commercialization success of green product initiatives. Estimated to be worth $30 to $40 Billion annually by 2010, the expanding green building market provides important opportunities for savvy PA manufacturers to develop new products and materials. There is a tremendous leadership opportunity to bring product innovations to market and to provide a commercialization strategy that will enhance access for PA manufacturers to the product selection process used in green design. GreenSim will provide Pennsylvania's green product and materials manufacturing sector with vital access to the green building design process and enable it the greatest possible opportunity to successfully inject their products into the marketplace. Coupled with incentives to accelerate their products to market, the PA manufacturing sector will capture a substantial market.

***Project Overview:*** To ensure the successful uptake of green and environmentally innovative products in the building industry, research is needed on the material and product selection processes in design. This project will study the design process to research the crucial issues and decision processes in material and product selection in order to identify access and targeting strategies that enable the highest uptake of green and in building design. Leveraging important research being conducted at Penn State's Lean and Green Research Initiative, a process modeling protocol will be employed to empirically research the design process of green building. The results will be integrated into a commercially available simulation product called GreenSim.

This product will be of value to owners and designers of green projects, primarily commercial scale, who want to know the best moments in design to make material and product decisions; as well as to green product manufacturers in PA and their marketing partners who want to target their commercialization and sales efforts at design decision makers to have much more timely and meaningful impact than is currently the case.

***GBA Product Innovation Grant Amount:*** $81,062

***Leadership Team:*** The project team includes Penn State University's Dr. Michael Horman, Associate Professor of Architectural Engineering and Executive Director of the Lean and Green Research Initiative; Dr. David Riley, Associate Professor of Architectural Engineering and Executive Director of the Center for Sustainability; Lisa Iulo, Assistant Professor of Architecture; and Jeff Deimer, graduate student. Penn State is partnering with Burt Hill's John Brock, AIA, Managing Principal of the central region offices; Pete Moriarty, President and CEO; Jill Swensen, Principal; and Gina Baker, Director of Sustainable Design.

***Contact:*** Dr. Michael Horman ▪ Penn State University ▪ 814.863.2080 ▪ mjhorman@engr.psu.edu

# Improved Production of Pigment as a Byproduct of the Treatment of Coal Mine Drainage in Western Pennsylvania

***Impact:*** The expansion of pigment production from minewater treatment systems will make sustainable treatment of polluted coal mine drainage feasible. Increased production of EnvironOxide™ will provide wood, cement, paint, and plastic manufacturers in western Pennsylvania with a local pigment choice that will assist them in making their products more environmentally friendly.

***Project Overview:*** In 1999, Iron Oxide Recovery (IOR) was formed to develop production processes and markets for iron sludge produced at coal mine drainage treatment facilities. Under its trademark EnvironOxide™, IOR produces an iron oxide pigment from wastes associated with coal mining and sells it to the paint, concrete, and coatings industries. To date, IOR has successfully recovered 3,000 tons of processed iron oxide sludge, but there is much room for growth since only a fraction of the available wastes have had pigmentary characteristics suitable for recovery and sale. In 2003, EnvironOxide™ was named one of the Top 10 New Green Construction Products by BuildingGreen.com.

IOR will work with the University of Pittsburgh to determine the chemical and physical attributes of minewater sludge that produce valuable pigmentary characteristics and use this information to significantly expand production of IOR's EnvionOxide™ product in western PA.

***GBA Product Innovation Grant Amount:*** $81,564

***Leadership Team:*** The project team is lead by Dr. Robert Hedin, the principal of Iron Oxide Recovery and Hedin Environmental who also serves as adjunct faculty at the University of Pittsburgh. The team also includes Dr. Rosemary Capo, a professor in the University of Pittsburgh Programs in Geological and Planetary Sciences. Dr. Capo and her students have developed expertise in coal mine drainage and chemistry and have worked with Dr. Hedin on several projects over the years.

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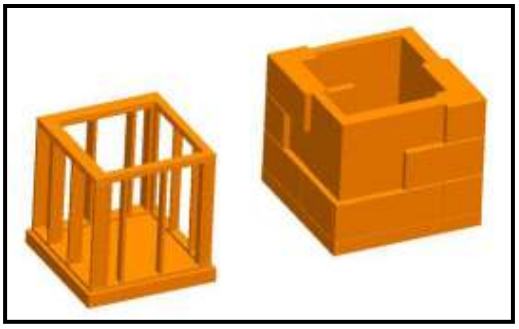
# Investigating the Environmental Life Cycle Assessment, Performance, and Costing of Expanded Polystyrene for Construction Materials and Supplies

***Impact:*** Insulating concrete forms (ICFs) are expanded or extruded polystyrene forms that stay in place as part of poured concrete walls. It has been proposed that the benefits of ICFs include high-performance energy savings, increased indoor air quality, solid structural performance, efficient construction activity, and reduced site disturbance. ICFs have been around for several years, and while the market is growing steadily, ICFs have not made a full market breakthrough. Certifying the economic and environmental impacts of using ICFs will result in increased demand for ICFs for new commercial and residential construction, as well as potentially exponential growth in production and jobs.

***Project Overview:*** This project will investigate the environmental and economic benefits associated with ICFs. The project team will conduct an environmental life cycle assessment (LCA) that includes a life cycle cost breakdown, as well as perform a comparative analysis of ICFs and traditional construction methods to assess the product's environmental and economic performance. Project results will include a third-party validated LCA that will establish environmental metrics and benchmarks and recommend process improvements.



Tegrant Corporation is currently the largest ICF manufacturer in North America. With this analysis of ICFs economic and environmental impacts, Tegrant will be expanding its current marketing strategy to include small contractors, large homebuilders, commercial builders, and resort owners/developers.

***GBA Product Innovation Grant Amount:*** $100,000

***Leadership Team:*** The project team includes the University of Pittsburgh's Dr. Melissa Bilec, who is Co-Director of the Center for Sustainable Transportation Infrastructure, Assistant Director of Education and Outreach at the Mascaro Sustainability Initiative, and Research Assistant Professor in the Department of Civil and Environmental Engineering. Fellow University of Pittsburgh faculty on the project team include Dr. Amy E. Landis, Assistant Professor in the Department of Civil and Environmental Engineering, and Dr. Kim L. Needy, P.E., CPIM, Associate Professor in the Department of Industrial Engineering. The private sector partner is Tegrant Corporation, represented by Robert Niklewicz, Vice President of Engineering, and Kevin Grogan, Vice President of Marketing and Business Development.

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**Awarded December 2007**

# Sustainable, Affordable, Low-Temperature Water System to Heat and Cool a Neighborhood of Buildings

***Impact:*** Pennsylvania's tremendous water resources represent a rich supply of renewable energy that is largely untapped. In fact, all of the Commonwealth's historic towns and cities were founded on top of and adjacent to these resources. Development and redevelopment with geothermal networks will support sustainable economic growth, energy efficiency, a reduced carbon footprint, and significantly lower energy costs. The market for this product includes owners and developers of mixed-use developments or redevelopments, data centers, technology parks, retail centers, college campuses, hospitals, and manufacturing facilities.

***Project Overview:*** This project team will design an innovative central aquifer loop linked to building heat pump loops, manufactured and developed by Geothermal Energy Systems, Inc. (GESI). This dual-loop system will be a sustainable method to heat and cool buildings using renewable energy rather than fossil fuels, which will allow for ongoing energy- and water-efficiency, utility cost savings, and reduced carbon emissions. The project team will meter and make final design improvements to GESI's newly patented aqua-thermal system.

***GBA Product Innovation Grant Amount:*** $45,736

***Leadership Team:*** The project team includes Vivian Loftness, FAIA, Professor in the Center for Building Performance & Diagnostics at Carnegie Mellon University (CMU); Nina Baird, Graduate Student at CMU; Gerald Mattern, P.E., Adjunct Professor at CMU and in private practice specializing in geothermal system installation; and Robert Yoder, Sr., President and CEO of Geothermal Energy Systems, Inc.

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# Low-Energy Luminous Surfaces: Residential Lighting Using Ceelite LEC Technology

***Impact:*** The need for alternative energy-efficient lighting systems that reduce energy consumption is increasing as incandescent light sources are being phased out of use and production. CeeLite has developed a Light Emitting Capacitor (LEC) technology that simulates daylight, generates minimal heat, and is made from recycled copolyester resins. An affordable, residential lighting system using CeeLite's LEC technology could revolutionalize the lighting industry by changing the way lighting technology is considered and affect the overall approach to interior illumination.

***Project Overview:*** Drexel University is leading a team to use CeeLite's LEC technology to develop a commercially viable lighting prototype for residential lighting applications that is cost effective, energy efficient and provides interior illumination with daylight qualities. Because the CeeLite LEC panel is a luminous surface, it is necessary to alter the perception of what constitutes a residential luminary, or light fixture, which will require a different methodology for lighting design itself. A well-designed prototype using LEC technology has the potential of being commercialized, manufactured and distributed for residential lighting applications.

***GBA Product Innovation Grant Amount:*** $20,000

***Leadership Team:*** The project team includes Dr. Eugenia Victoria Ellis, Associate Professor in Drexel University's Department of Architecture & Interior Design, the Westphal College of Media Arts & Design, and the College of Engineering. The team also includes several student researchers affiliated with the Drexel Smart House. CeeLite's team members are Gabrielle Santulli, Vice President of Marketing and Huei-Pin Huang, Chief Technical Officer.

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