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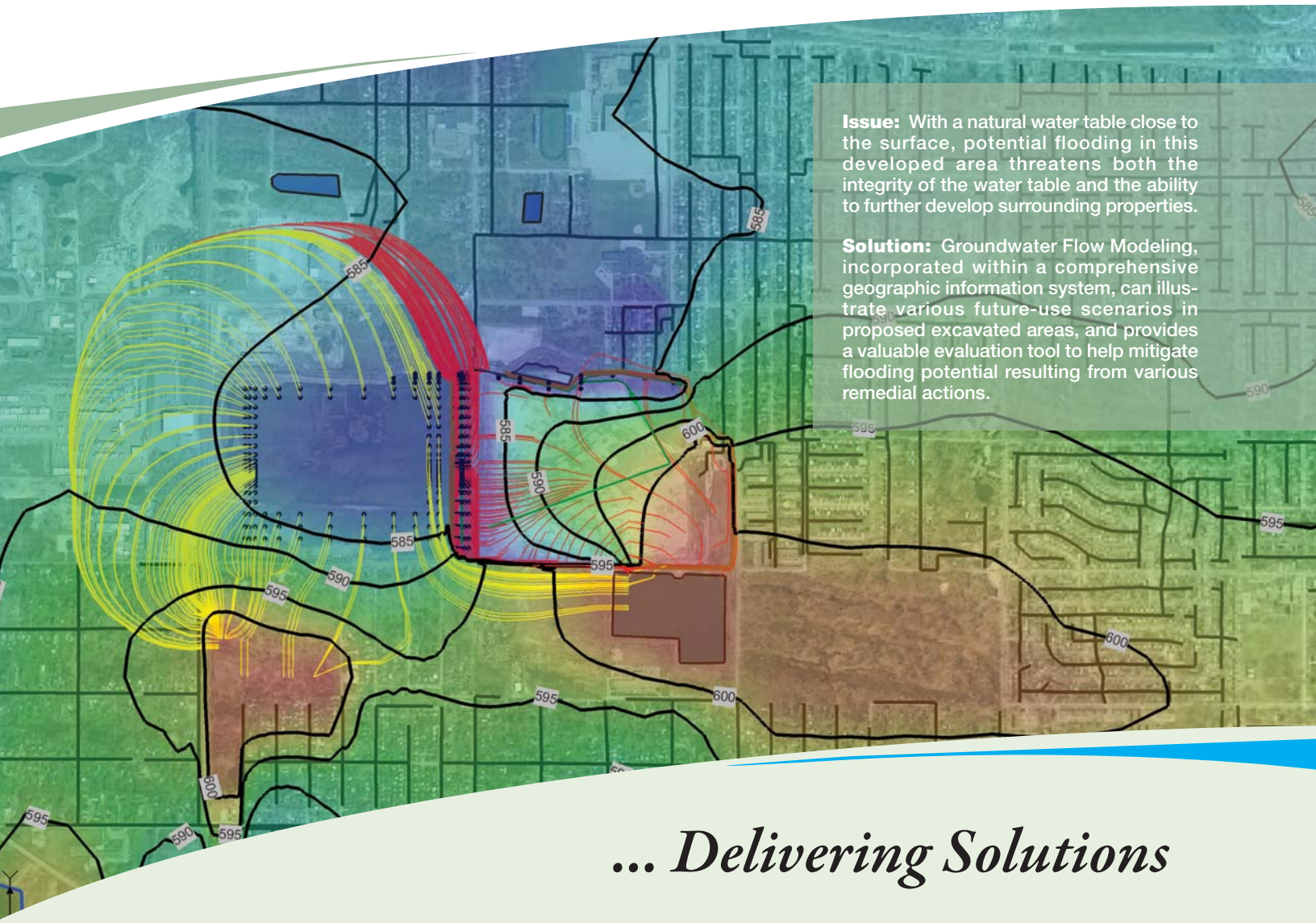

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Guest Editorial

Finding the Voice of the Engineer

John C. "Jack" Mascaro
Mascaro Construction Company, L.P.

John C. "Jack" Mascaro

In 2005, the commercial and institutional green building market consisted of approximately $3 billion or 2% of the total market. In 2013, it is estimated that the green building market opportunity will be $70 billion, or approximately 20-25% of the total market (Source: McGraw Hill Construction SmartMarket Report: Commercial & Institutional Green Building).

It is obvious to even the most cynical that green building, sustainability and LEED are not a fad and are here to stay.

Consequently, owners see the chance to improve building performance by lowering their energy costs. Contractors and A/E firms need to be knowledgeable about sustainable principles and provide LEED consulting services because their clients are demanding it, especially during the early phases of the construction process.

If we choose to adopt sustainable principles, we can significantly impact our use of natural resources and the environment. According to the U. S. Green Building Council (USGBC), the building design, construction and operations industry annually consumes more than 30% of the total energy and more than 60% of the total electricity used in the United States. In 2006, the commercial building sector produced more than 1 billion metric tons of carbon dioxide, an increase of more than 30% over 1990 levels. Each day, 5 billion gallons of potable water are used solely to flush toilets. A typical North American building generates about 1.6 pounds of solid waste per employee per day; in a building with 1,500 employees, that can amount to 300 tons of waste per year. Development alters land from natural, biologically diverse habitats to hardscape that is impervious and devoid of biodiversity. The far-reaching influence of the built environment necessitates action to reduce its impact. (Source: Green Building Design and Construction LEED Reference Guide for Green Building Design and Construction for the Design, Construction and Major Renovations of Commercial and Institutional Building, 2009 Edition).

Along with this tremendous change in green building markets, there will be an appropriate increase in regulations governing land and water use, energy, carbon emissions, material manufacturing and indoor air quality. It is this author's belief that most of the regulations governing these items are written by politicians, lobbyists and other policy wonks and not engineers.

Engineers need to stand up and control their destiny and develop a national voice on these issues. As significant energy consumers and innovators, there is much we can contribute; but we have to enter the conversation.

To develop a perspective of why we should be involved on a national basis, let's look at the definition of engineering. "Engineering is the application of science and mathematics, by which the properties of matter and the sources of energy in nature are made useful to people." I like that. On the one hand, it defines the outcome of our work as things that are useful for people. On the other, it puts our work in the context of math and science, where the rules are true and right and wrong are clearly defined.

"Engineers need to stand up and control their destiny and develop a national voice on these issues"

Engineers know that there is clarity in science and math; more clarity, certainly, than the arguments going on in our country on the most vital issues facing our people. But today the public and, more importantly, our public leadership, have lost confidence in what we say as engineers. Too often today public opinion leaders, political leaders, and advocacy groups that represent specific points of view seem to turn away from the solutions based on

science and engineering, and instead embrace ideas that can be called popular, at best.

So why then is a definition of engineering something we've taken for granted for centuries, seen as news today? Let me answer with a question. Why is it that the leadership in so many public policy areas, environmental solutions, healthy buildings, seems to be left in the hands of "policy experts" and "advocates?"

Why is it that solutions to problems are new laws and new regulations, most of which are inflexible and few of which encourage engineering innovation? Why do lawyers and judges seem to be the ones who are the final arbiters for so many public problems that are dependent on science for solutions? Let me ask the question another way. Where is the voice of the engineer today as we try to provide clean water to people, improve health, keep the environment healthy, and do other useful things for people? I, for one, think our voices have been muted. A fact that carries with it high costs to everyone. The truth is, we must fault ourselves for the lack of visibility of the profession on the national stage.

As educated professional engineers and business people, we have not been proactive in leading the discussions of important issues, in providing leadership nor in demanding attention. We must do better. We must be heard. What we've failed to do is create organizations that are first very credible and second, that are seen

"...engineers need to be innovative, creative and show leadership and create policy and legislation that works for the common good..."

and heard by the public and public leaders. To find our voice, we must foster organizations that put engineers and engineering on an equal footing with political interests and special interest advocates.

Many public officials, lawyers, architects and opinion makers as well as average people look to the Sierra Club and the USGBC for leadership on environmental issues and sustainability. My questions is: what engineering organization does the public recognize for leadership and guidance as we tackle various environmental issues like better utilizing resources, controlling pollution, and constructing healthy buildings? Who is the objective arbiter when points of view conflict on these issues? Probably a lawyer.

We as engineers need to be heard if we are going to have an impact on serious national issues. As a nation and as a world, we need to take a hard look at how we live, how we consume, how we build, how we utilize resources, what products we need, and how we design and make them.

Economists, public policy people and architects led the research on the need for sustainability and designed most of the strategies for achieving change. The troubling fact is that, to date, engineering contributions to this vital process have lagged significantly behind the work of those professions.

I believe that some engineers avoid risk and are reluctant to

Guest Editor's Note

I have invited a group of notable experts from eclectic backgrounds to contribute their ideas on sustainability for the Pittsburgh Engineer.

David A. Dzombak is the Walter J. Blenko, Sr. Professor of Environmental Engineering in the Department of Civil and Environmental Engineering at Carnegie Mellon University. Jeanne. VanBriesen is the Director of the Water Quality in Urban Environmental Systems (Water QUEST) Center and a Professor in the Department of Civil and Environmental Engineering at Carnegie Mellon University.

David and Jeanne tell us about the problems that Southwestern Pennsylvania faces without significant modifications and improvements to our wastewater, stormwater, potable water and lock and dam systems. The reinvestment in these 50-100+ year old systems should be done in a manner that will enhance the quality of life in our communities and our economy. It should require new designs and approaches to operation and maintenance in order to achieve a more financially and environmentally sustainable water infrastructure.

Dr. Gregory Reed is Director, Power & Energy Initiative and Associate Professor, Electrical & Computer Engineering Department in the Swanson School of Engineering at the University of Pittsburgh.

Dr. Reed talks about the thirst both nationally and globally for increased energy demand, how it is impacting our antiquated and inefficient infrastructure, the opportunities this will provide for technology development and innovation as well as economic development and job growth. Dr. Reed goes on to tell about the University of Pittsburgh's Power & Energy Initiative as it relates to smart grid related activities and the research projects and other activities in the smart grid area being supported by regional industry leaders.

Tom Paladino is a nationally recognized leader in sustainability. He is an engineer, architect and the founder and president of Paladino and Company, a green building and sustainability consulting firm in Seattle.

Mr. Paladino talks outside of the box as he discusses how the climate change, financial instability and demographic shifts have created competitive advantages for the future, particularly for engineers. He notes that Pittsburgh has been a leader in systematically welcoming green building and how Pittsburgh is positioned to provide growing opportunities for engineers to apply design thinking.

Dr. Eric J. Beckman is the co-director of the Mascaro Center for Sustainable Innovation as well as the Chief Science Officer for Cohera Medical Inc., the company he co-founded with Dr. Michael Buckley.

Dr. Beckman dispels the myth that sustainability is perceived to limit design options, reduce functionality and raise costs by explaining the research being conducted at the Mascaro Center for Sustainable Innovation at the University of Pittsburgh and how the use of sustainability concepts at the front end of design expands the ability to produce radical innovations.

Janice Webb Donatelli is the owner of ARTEMIS Environmental Building Materials, a wholesale/retail business located in Pittsburgh, PA.

Janice is an entrepreneur who mentors minority business owners and consults with small business and manufacturers on sustainable practices. She is involved with Green Building Alliance Product Initiative, Sustainable Pittsburgh Business Climate Initiative and Allegheny River Visioning. Janice also performs educational outreach and speaking engagements throughout the area.

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make a decision because they are afraid to make a mistake (and will not pull the trigger). Engineers need to be proactive and speak out against some of the untenable regulations that are being forced on their businesses. We need to find our voice.

John P. Bachner, Executive Vice President, Associated Soil and Foundation Engineers (ASFE) in his January 2010 CE News article says that "lawyers are ruining engineering because of the ever present risk of negligence litigation." Lawyers can help, but engineers need to control.

Our educational institutions need to adjust their curriculum and teach entrepreneurship, leadership, law, economics, politics and communication skills as integral parts of the engineering curriculum. This is not a new idea and the major obstacle to this implementation is that university officials say there is not enough room in the current curriculum to add these courses. My response is, extend the educational process for another year to accommodate the extended curriculum and offer two degrees.

As Kenneth Blanchard says, "The key to successful leadership today is influence, not authority." Are we teaching our next generation of engineers the skill of influence? It's not enough to smugly "know better" – we need to find our voice to impact those around us to solicit change.

In summary, engineers need to be innovative, creative and show leadership to create policy and legislation that works for the common good of everyone, not just special interests.

The current opportunities that green building and sustainability offer could well be the bridge that engineers need to foster a leadership voice on a national scale. That is, if we turn ourselves off of "mute." PE

About the Guest Editor

John C. Mascaro is chairman and founder of Mascaro Construction Company, L.P., the country's 203rd largest Contractor and 57th largest Green Contractor. He is a registered professional engineer in four states and a LEED® Accredited Professional. He holds Bachelors and Masters degrees in Civil Engineering from the University of Pittsburgh and was the 2003 recipient of the Metcalf Award from the Engineers' Society of Western Pennsylvania.

THE END OF THE ENGINEERING BOX!

By: Tom Paladino

There is an emerging 21st century market condition of global drivers that have exposed weaknesses in established business models and practices. Climate change, financial instability and huge demographic shifts have created a drastically shifting landscape. This highlights the need for transformative thinking and action to create more durable and adaptable societal structures, companies and workforces. The end state that must be reached to overcome these drivers can be thought of as the "green economy."

The Emerging Green Economy

The green economy is a new global market in which sustainability provides the key competitive advantage and durability the successful organization of the future must embrace. Previously seen as a marketing tactic or a way to conciliate regulators, organizations are now beginning to view sustainability as a necessary tool to create competitive advantage, refresh stagnant business or operations models and remain globally relevant while growing their triple top line asset base of human, natural and financial capital.

As organizations and industries transform into green economy businesses, workforces will need to adapt, re-skill and rethink the way they work. Engineers in particular will have the opportunity to play key roles in developing new innovations in response to this new way of conducting business. Of all the professions, this type of "design thinking" to conceptualize new solutions is most aligned to the engineering academy – but only if the engineers can overcome their own temperament.

Green Building — A Market Transformation Model

With buildings as one of the leading consumers of energy and water, as well as significant producers of green house gasses, companies have come to recognize the value of owning and operating high-performance buildings to their financial, human and environmental bottom lines. To date, green building has been one of the most successful and widely adopted sustainable initiatives, and can serve as a model for other parts of the green economy.

One important outcome of the success of green building is how it has affected the people involved in delivering and using these buildings. Entire project teams—contractors, architects, engineers and commissioning agents, among many others—have learned to rethink the building as an integrated system. Ultimately, sustainability becomes more than an end result; it transforms an entire industry supply chain and the people, including engineers, who manage it.

The problem for engineers in this model is that not all players think systematically, nor are engineers thought of first when a design leader is needed. Why is that?

I believe this problem is rooted in our most fundamental engineering design tool: the control volume. Every engineer is taught to draw box around the problem and then study what goes in and what comes out. With enough data and inspection, the system equation for the box can be revealed, and then optimized.

It's brilliant in its simplicity and efficient from a design perspective, but it is also why many of our buildings perform like boxes. It eliminates random and beautiful input of secondary information. It can strip creativity from the solution set. It's why people talk about innovation as "designing out of the box!"

So the first order change for engineers as the profession adapts to the new green economy is to stop focusing on the box. Yes, you need an inventory of the relevant facts and issues, but you also need an idea of where you're going. Focus on the outcome that is desired. Identify the elegant and efficient results that indicate success. Then think about the solution—it probably doesn't come in a box.

Occupants, owners, facilities managers and

maintenance staff are also recognizing the need to change the way they operate and work inside buildings. It is no longer enough to ask "what equipment must I manage?" Rather the question becomes "what is the preferred environment I am trying to create, and how can I do that with as little budget and infrastructure as possible?" This kind of thinking led to the myriad of solar shading devices that engineers designed for the outside of the Alcoa building—Alcoa prefers daylight without glare. Or the sweeping and structurally efficient roof of the David L. Lawrence Convention Center (DLLCC) that supports natural ventilation. The Center prefers free cooling for the vast exhibition areas.

Pittsburgh's Convention Center features natural ventilation through effective design

Similarly, product manufacturers have innovated in response to growing demand for green building components with evolving requirements for performance. Glass is no longer a static, prophylactic envelope material. It is a permeable membrane, that selectively admits light and blocks heat, that is tuned for natural spectrums and that can change properties depending on conditions. Sophisticated products need a new sales process, because some of the engineering customers will still be trying to buy solutions that come in a box.

Pittsburgh's Role in the Green Economy

Pittsburgh is playing a key part in the green economy as a model of market transformation. From its legacy as the "Smokey City" to its current reputation as an economically diverse, sustainable city that earned a spot on Forbes list of hottest green collar job markets in 2008, Pittsburgh is well known as a city willing to embrace change. Though not yet without challenges, the city is striving to build a reputation as a hub for sustainability, integrating its buildings, industry and citizens.

In the "brown" economy of old Pittsburgh, coal and iron were prevalent natural resources to be exploited, financial prosperity was found in manufacturing and steel production, and the workforce was siloed into heavy industrial roles. By 1911, Pittsburgh was the nation's eighth largest city, attracting engineers and workers seeking well-paying steel mill jobs; however, streetlights burned 24 hours a day because of the heavy smoke. By the 1950s Pittsburgh's rates of respiratory illness were some of the highest in the nation.

After the decline of the steel industry in the 1980s, Pittsburgh had to step outside its own box to re-examine the kind of business it wanted to attract. As a city, Pittsburgh was one of the first in the nation to systematically welcome green building, with more than 30 LEED-certified projects, including one of the first LEED Silver office buildings (PNC Firstside) and the first LEED Gold certified convention center (DLLCC).

Pittsburgh's legacy of manufacturing and energy is still alive, but it has transformed to respond to the changing market. Now, advanced manufacturing, engineering and technologies companies such as Alcoa, PPG Industries and smaller clean tech companies call the city home. The combination of research and education facilities such as Carnegie Mellon, with the valued added to local raw materials such as aluminum and glass through engineering innovation, positions Pittsburgh well. As a center for both conceptualizing and manufacturing products and systems, it is poised to provide growing opportunities for engineers to apply design thinking.

Design thinking has been applied by engineers at the city scale as well. The Mascaro Center for Sustainable Innovation at the University of Pittsburgh is focusing on sustainable neighborhoods. There, engineers are breaking out of the box, thinking of ways for infrastructure to double as an amenity. Can a stormwater treatment pond become a park? Is there a way for nature to function as infrastructure? The answer is yes, based on the recently opened Rutledge Borough's Triangle Park. The park combines porous basketball courts with rain gardens to manage stormwater flows. That's out of the box!

The Future for Engineers

For many engineers, the past century has been dominated by direction from architects, product merchandising, and information technologists. Those problems were often handed off to engineers in a box, who not surprisingly returned the answer in the same box.

But as global drivers for sustainability demand more creative solutions across all industries, there is a new role that the engineer can play: design thinker. This means remaining open to definitions of success that are outcome based, not implementation or technology based. It means collaborating rather than reporting out; it means hypothesizing results rather than proselytizing familiar solutions. It means leading by example. PE Don't just get out of the box; get rid of that darn box!

About the Author

A nationally recognized leader in sustainability, Tom Paladino is an engineer, architect and the founder and president of Paladino and Company, a green building and sustainability consulting firm in Seattle. He has supported many Pittsburgh-area clients through their own design

Sustainability and Tomorrow's Engineers:

Is Sustainability Compatible with Engineering Design?

By Dr. Eric J. Beckman

Engineering incorporates design as its centerpiece. Indeed, one of the key attributes of engineering curricula that sets them apart from their cousins in the arts and sciences is the capstone senior design class, where all of the fundamentals that have been learned in the preceding 3 years are synthesized into a coherent whole and focused at a problem of current interest. In design, engineering students are typically asked to create a product or process that meets certain specifications (the constraints) at minimum cost. The specifications incorporate both functional and safety considerations, with cost always lurking in the background as that great destroyer of promising ideas. Along the way toward their final designs, the problem solving ability of the students is tested as they find that the various specifications don't always "work and play well with each other" – as an alteration to the design allows one spec to be met, often another falls out of the preset boundaries. Finding the happy medium (with the accompanying lesson that there rarely is one right answer) is often the most important "aha moment" for our engineering students. In addition, there comes the realization that some specifications are cast in stone, while others…are fuzzier. After years of grinding through the fundamentals, students facing design are sometimes rather surprised by the inherent uncertainty in the process.

At the Mascaro Center for Sustainable Innovation, we believe that sustainability not only compliments, but enhances traditional design. Sustainability naturally adds additional degrees of uncertainty, making its incorporation into the education of the next generation of engineers (both undergraduate and graduate) challenging. Sustainable designs are those that reduce environmental footprint, improve society, and operate efficiently at reduced cost versus their conventional analogs. Point three (cost) is of course familiar to all engineers, while point two was introduced by Henry Ford a century ago, when he proposed that if he created a viable wage for his workers, they would readily be able to afford his product. While quite controversial for the time, it helped lead to resounding early success. Reducing environmental footprint is sometimes difficult to envision, given the substantial number of metrics that one can use to measure environmental quality. When students examine the cost of their designs, they usually look at first cost only (perhaps operating cost as well), but costs owing to long-term use, end-of-life costs, and the costs to the environment and society over the lifetime of the product are not typically considered.

Another difficulty in employing sustainable design concepts in engineering education is the unfortunate tendency to associate sustainable design with simply "design with extra regulatory constraints". Indeed, engineers have always incorporated regulatory concerns into their designs – buildings and bridges must pass rigorous safety inspections, chemical products cannot produce toxic responses in customers, and new widgets cannot endanger the lives of the people who buy them. The longstanding use of these regulatory constraints in design has prompted some in the engineering community to see sustainability as simply "more regulation masquerading as a social movement". As such, sustainability is perceived to limit design options, reduce functionality, and raise cost – this heuristic is unfortunate, but pervasive among both engineers and their customers.

"Another difficulty in employing sustainable design concepts in engineering education is the unfortunate tendency to associate sustainable design with simply 'design with extra regulatory constraints'"

So, we are faced with the questions "how to deal with the unfortunate reputation of sustainable products" and "how do we effectively introduce concepts of sustainable design into the engineering curriculum?" Regarding the first point, our premise is that if sustainability is not

introduced into the product creation process until the design stage, then it is likely to lead only to incremental improvement in environmental footprint with a reduction in performance and an increase in cost. Sustainability should be introduced into the process at the concept formation stage; these points were echoed by Dr. Stuart Hart (Cornell Business School) in his famous article in the Harvard Business Review in 1999. In addition, there are some simple ideation themes (aka a creativity template) one can follow at this stage to help create more sustainable outcomes:

- System defined by desired customer outcomes
- Innovation by subtraction
- Use of "free" resources
- Multi-use rather than single use

Further, if one is to achieve a more sustainable outcome, one must employ a system by which to measure changes in environmental footprint. Within MCSI, Drs. Melissa Bilec and Amy Landis (Civil & Environmental Engineering (CEE)) examine the use of life cycle analysis/life cycle impact (LCA/LCI) metrics to determine whether ostensibly sustainable designs are truly more environmentally friendly than their conventional analogs. LCA examines a product's life cycle "inventory" – i.e., all of the inputs to, and outputs from a products creation, use, and disposal. LCI takes the data from an LCA and creates a list of indicators for sustainability, i.e., a grade report (or score card) allowing one to compare one product to another. The score card consists of numbers that represent impacts in terms of surrogates – for example a product's impact on ozone depletion is measured in the number of CFC-11 equivalents that it emits over its lifetime. Where environmental footprint is concerned, as in golf, lower scores are better! The use of LCA/LCI can both guide design (at the front end) and peer into the complex life cycle of an existing product to look for "red flags". For example, Dr. Landis' group has examined the LCA/LCI of "bioplastics" (for example, polylactic acid, created from lactic acid, which is itself created from corn sugar by fermentation) as compared to that conventional petroplastics (such as polyethylene or polypropylene). While polylactic acid uses less fossil fuel (per pound) than its petro-based cousins, the biopolymer produces a much higher eutrophication impact. Eutrophication occurs whenever one farms intensively – fertilizer (phosphorous and nitrogen) is applied to the soil, where some inevitably washes off and enters streams, then rivers, then ultimately (in the case of the US) the Gulf of Mexico via the Mississippi. The nutrient laden fresh water, combined with plentiful sunshine, creates an algal bloom – as the algae die and decay, they extract the oxygen from the water, leading to an enormous dead zone off the coast of Louisiana. Hence, if you're an Iowa farmer, bioplastics represent a great new market for your product, while if you're a Louisiana shrimp fisherman, economic and environmental disaster.

"...if you're an Iowa farmer, bioplastics represent a great new market for your product, while if you're a Louisiana shrimp fisherman, economic and environmental disaster"

My own group has used LCA/LCI metrics at the front end of the design process to conceive a green replacement for PVC in water pipe. PVC employs energy-intensive chlorine in its manufacture, and some of the intermediates to its synthesis are carcinogenic. While plastics such as polypropylene and polyethylene have been proposed as replacements for PVC, LCA/LCI reveals something curious – as you examine the life cycle of PVC versus these other polymers, you note that all depend to a great extent on the use of simple olefins (ethylene, propylene) in their manufacture, and that it is the olefins that dominate the impacts. Further, because PVC is so much stronger than the polyolefins, one needs to use more to create the same length of pipe – as such, when you compare the LCA/LCI of PVC versus, say, polypropylene on a per pipe length basis, there is no clear cut "winner". This led us to propose the use of glass fiber-reinforced polypropylene as a viable replacement for PVC, where the glass fiber both strengthens the material (hence requiring less per length of pipe) and lowering the overall impact of the material. LCA/LCI metrics show such a compound to be a clear environmental winner, and the price is competitive as well. Given the importance of metrics, many of the graduate students associated with MCSI (from multiple engineering departments) take an LCA course.

Returning to the creativity template described above, the use of these simple heuristics can point the way to new, more sustainable systems, but only if validated through the use of LCA/LCI metrics. Several research groups

associated with MCSI are creating new more sustainable designs using some of these concepts. For example, Di Gao (Chemical Engineering) and Kent Harries (CEE) are examining the creation of superhydrophobic surfaces using tailored nanoparticles to reduce the degree of icing on roadways – rather than create more benign road salt or more efficient road salt, these researchers are looking to eliminate the need for salt by preventing water from lingering on the surface long enough to form ice.

With respect to "use of free resources", a number of our research groups are looking at ways to recover and use energy that would normally be "lost". For example, Lisa Weiland (Mechanical Engineering & Materials Science (MeMS)) has designed a system that can recover energy from swift-flowing but shallow rivers. Such streams are usually inappropriate sites for generation of hydropower (and new dam construction is very damaging to the environment). Dr. Weiland's innovation employs a novel airfoil type moving part combined with the use of electroactive polymers to extract energy from the stream without changing the flow pattern or harming wildlife. Another group led by Dr. Harries (CEE) has created a system that can be used to extract energy from the turbulent airflow around tall buildings – ordinarily the stresses created by such turbulent flow are dissipated through use of structural additions to the building, while here these stresses are essentially "put to work". Finally, a collaboration between Laura Schaefer and Buddy Clark (MeMS) has created switchable insulation to harvest free energy that usually simply lost. For example, on a sunny winter day the solar energy absorbed by the roof of a typical house cannot be used to heat the house – the attic insulation (by design) prevents this. Drs. Clark and Schaefer have created insulation that can be actuated – turned on and off, to allow one to harvest this "free" energy when it is available while insulating the house when this energy is not available (as on cloudy days or at night).

In summary, to bring concepts of sustainable design into the engineering curriculum, it is important to emphasize that one can gauge the relative sustainability of a product or process through the use of metrics – in engineering we prize the ability to measure those things we find important. Further, rather than restricting creativity and innovation, the use of sustainability concepts at the front end of design expands our ability to produce radical or disruptive innovations. Current students have grown up in an era where environmental concerns are mainstream, and where radical innovation is almost routine. As such, bringing sustainability into the engineering curriculum is much less difficult than it might first seem.

PE

About the Author

Dr. Eric Beckman is the co-director of the Mascaro Center for Sustainable Innovation as well as the Chief Science Officer for Cohera Medical Inc., the company he co-founded with Dr. Michael Buckley in 2004. Dr. Beckman's research focuses on molecular design to support (a) creation of greener chemical products and (b) synthesis of materials to support biomedical research. He received Presidential Green Chemistry award in 2002.

Water Infrastructure Sustainability Challenges for Southwestern Pennsylvania

By: David A. Dzombak and Jeanne M. VanBriesen

Water is a tremendous asset to Southwestern Pennsylvania. Our region is fortunate to receive ample precipitation – about 39 inches per year – distributed fairly uniformly over the course of the year. Our water resources have been critical to development of our region, initially establishing Pittsburgh as a water transportation hub, and then providing a means for supplying, supporting, and connecting to the world the industrial production capacity of Pittsburgh. Today, the same water resources are used for a broader range of purposes, including municipal water supply and recreation in addition to transportation and commerce. Our water resources remain critical to the future of the region – as a resource attractive for its value to industry and new residents.

Over the past 150 years we have built up an extensive, complex infrastructure to manage and use our water resources to support the expansion of our communities and our economic growth. This infrastructure includes potable water treatment and supply systems; wastewater collection, conveyance, and treatment systems; stormwater collection and conveyance systems; a lock and dam system for year-round navigation and bulk material transport on our rivers; a system of 16 major flood control dams and reservoirs; and numerous small dams to impound water for industrial and recreational uses. The water supply systems were installed first, beginning in the mid 1800's, and leading to greatly increased per capita water use, and the need for a stormwater and wastewater collection system that directed the excess water away from our cities and towns and into our streams and rivers. This was followed by the lock-and-dam systems beginning in the late 1800's and into the early 1900's. The major flood control projects were installed beginning in the 1940's, initiated in response to the great St. Patrick's Day flood of March 1936 which inundated large portions of the City of Pittsburgh. Finally, following much later than collections systems, centralized wastewater treatment was installed to reduce the effects of direct discharges to local waterways. The City of Pittsburgh and most of Allegheny County finally had wastewater treatment in 1959 when the Allegheny County Sanitary Authority facility opened.

As was typical of infrastructure development in most U.S. cities, project development, capital financing, and political approval were the primary foci at project initiation. Long term operations and financing of those operations was of secondary concern. This is certainly understandable, as infrastructure development took place in Pittsburgh as in many other cities in spurts of activity with various coalitions and funding mechanisms involved. The beginning of the water supply system in Pittsburgh, for example, was entirely driven by private companies working with neighborhood groups. Only after a number of private systems were installed and more were in development did the City get involved. Obtaining wastewater treatment for Pittsburgh was a long, arduous process that began in the 1930's. Getting agreement among dozens of communities in Allegheny County and the City of Pittsburgh to establish a wastewater authority and construct a wastewater treatment facility was quite an achievement at the time, even though some components of the agreement (such as all communities retaining ownership of their sewage conveyance systems) are now easily recognized as not conducive to efficient operation. Initial design and construction was the focus of these efforts, with long term operation and maintenance costs not routinely considered.

In the time since the installation of the infrastructure discussed above, from a small community water supply system to a navigation structure or flood control dam operated by the U.S. Army Corps of Engineers, much has been learned about what is needed for operation and maintenance of these systems, and the associated cost. Part of what has been learned is that investment in operation and maintenance of U.S. water infrastructure has been made at a rate lower than necessary to provide reliable, sustainable operations. This under-investment in operation and maintenance has resulted in many problems and engineering challenges as the need for water infrastructure renewal is confronted. Due to deferred investment in maintenance and renewal of our water supply systems, for example, distribution pipe failure is on the increase, and a significant volume of water is lost between treatment and use in the system as small leaks proliferate. Deferred investment in lock-and-dam facilities can lead to unsafe

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conditions and increased probability of failure. The original design of sewage collection that mixes stormwater and wastewater in a single pipe has led to the continued discharges of raw sewage during rainfall events, and these events are worsened by the disrepair of the system and the systematic under-investment in its maintenance.

The focal point of Pittsburgh's waterways is the confluence of its three rivers

In Southwestern Pennsylvania as in many other regions we now face the challenge of infrastructure renewal for our multiple water infrastructure systems simultaneously. Water supply distribution systems are in need of more systematic replacement and upgrade; the "fix-it-when-it breaks" approach is the inevitable result of the lack of funding and capacity to keep up with operation and maintenance needs, and places property and communities at risk of significant damage and disruption. While more than a hundred years of understanding of the public health risks of sewage discharges argues for the separation of domestic sewage and stormwater, we continue to struggle to manage and upgrade combined systems in ways that are economical and protective of human health.

Clearly, renewal of our water infrastructure is needed, but this is not the time to make simple replacements. The required re-investment argues that this is an opportunity to upgrade and advance our water infrastructure systems. We should not replace infrastructure installed 50-100+ years ago with the same technology today, any more than we would invest in a 50 year old phone system. It is time for a 21st century water infrastructure that is intelligent – an infrastructure that is sensed, managed and sustained through the advances in technology that have transformed so much of our built environment. Our existing infrastructure was designed with objectives that are insufficient to meet our needs for enhanced treatment (to remove new and emerging contaminants) and improved control (for security and to manage multiple uses). New technologies exist for sensing and controlling our water systems, just as they exist in other fields.

Management of stormwater is an important area in which objectives and approaches have changed. In the original installations of stormwater collection and conveyance infrastructure, a primary objective was to move water out of urban areas as quickly as possible. Streams in urban areas were often placed in pipes, as was done throughout the City of Pittsburgh. In addition, many stormwater conveyances were designed to carry sewage in the same pipe, leading to combined sewers. Results of these approaches to stormwater management include flooding and accelerated erosion in the streams where the rapidly overloaded stormwater pipes discharge during storms, unnecessary hydraulic loadings to wastewater treatment plants year round, loss of open streams and associated benefits in urban areas, and other problems. Today the benefits of retaining stormwater on watersheds for longer durations are recognized, and new approaches to management of stormwater have been developed.

Similarly, drinking water systems can achieve higher levels of control through sensing water quantity and quality as it moves in and out of treatment facilities, reservoirs, and out to our homes. Improved management of our many uses of potable water – for fire protection, for inside and outside household use, and for industrial use – is possible through new advances in data acquisition and information technology. These new highly sensing systems will reduce the number of costly and disruptive failures of water infrastructure systems, with attendant benefits for public health and safety, and for commerce.

"It is time for a 21st century water infrastructure that is intelligent – an infrastructure that is sensed, managed and sustained through the advances in technology"

In renewing our Southwestern Pennsylvania water infrastructure we should aim to implement systems that are more financially and environmentally sustainable, and that provide an equal or higher level of performance. Financially sustainable systems will be those that communities can afford to operate and maintain through user fees, without subsidies, which will be increasingly scarce as federal and state discretionary budgets continue to decrease. Environmentally sustainable systems will be those with low energy profiles, with spatial density, and those that incorporate as much local management of water as possible. For higher performance, we need to expand new technologies in treatment with improved monitoring

and control of water infrastructure systems.

Southwestern Pennsylvania has developed an extensive water infrastructure over the past century, which has managed our ample water resources for the benefit of our communities and our economy. As we renew of water infrastructure in the 21st century, we need to do so in a manner that will enhance the quality of life in our communities and our economy. This will require implementation of new designs and approaches to operation and maintenance to achieve a more financially and environmentally sustainable water infrastructure that performs to meet modern objectives.

The challenge of water infrastructure sustainability for Southwestern Pennsylvania and North America will be among the topics explored at the United Nations World Environment Day "Water Matters" conference which will be held in Pittsburgh on June 3, 2010. All *Pittsburgh Engineer* readers are encouraged to attend and learn about new approaches to water resource sustainability in communities and industry across North America. For more information, visit http://www.pittsburghwed.com. PE

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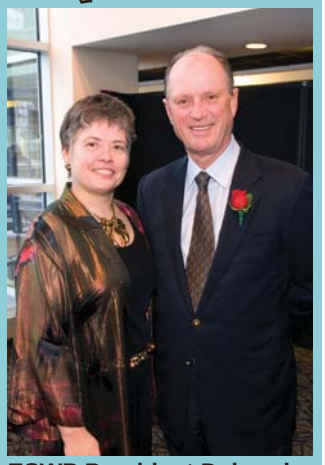
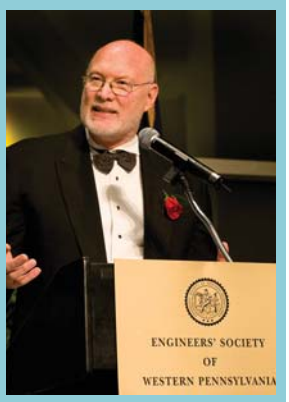
Scenes from the ESWP 2010 Annual Engineering Awards Banquet

Deb Lange presents 2009 ESWP President Anthony DiGioia with the Past Presidents Award



ESWP President Deborah Lange meets with Dr. Robert Ballard

2009 Metcalf Award Recipient Steve Tritch (L) presents the 2010 Metcalf Award to Dr. William "Red" Whittaker



2010 Recipient of the William Metcalf Award, Dr. William L. Whittaker

Guest Speaker Dr. Robert Ballard talks to the gathering of more than 575 guests about the importance of STEM Education

For more information about the 2010 Annual Engineering Awards Banquet, visit eswp.com/eswp/annual_banquet.

The Smart Grid Technology Revolution:

Links to Sustainability and Opportunities for Workforce and Technology Development

by: Dr. Gregory Reed

As the new energy economy in America continues to emerge, a key area of development known as the 'Smart Grid' is beginning to revolutionize the electric power sector and related industries. Smart grid concepts have direct links to sustainability in many ways, and offer tremendous opportunities for both workforce and technology development, leading to job creation, economic growth, and innovation.

Defining the Smart Grid:

The smart grid has many definitions, depending on what part of the electric power chain a given application is associated with or what industry perspective is being represented. However, as a general description, the smart grid can be defined as "the implementation of various enabling power system automation, communication, protection, and control technologies that allow real-time interoperability between end-users and energy producers, in order to enhance efficiency in utilization decision-making based on energy resource availability and economics." Within this broad definition, everything from improved energy efficiency in buildings to effective expansion of transportation electrification to the integration of higher penetration levels of clean energy resources and advances in power transmission & distribution system control will all be enhanced through effective smart grid implementation, as depicted in Figure 1.

The Need for a Technology Revolution:

The importance of the smart grid revolution rests not only in the advancement of power and energy technologies and operations, but also in terms of sustainability, economics, and societal impacts that have global relevance. In this context, it is critical to understand the general state-of-

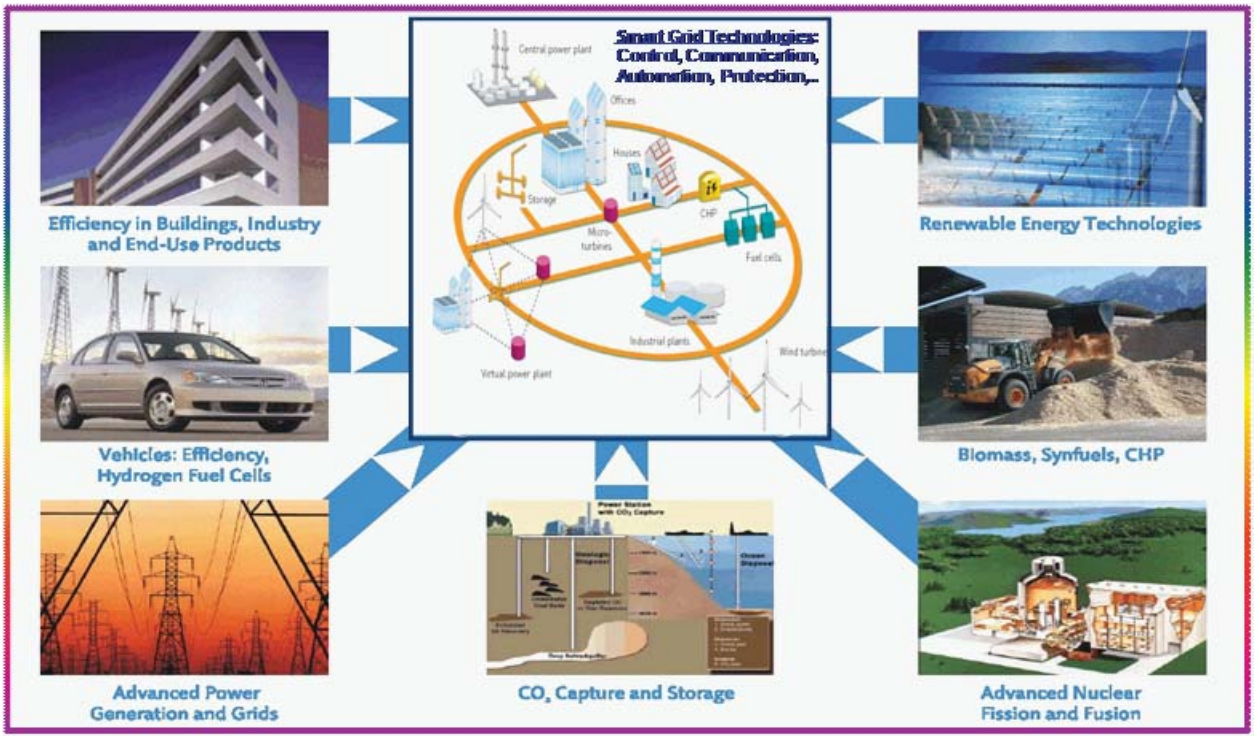


Figure 1 – Smart Grid Technologies for Enhanced Energy Efficiency and Clean Energy Integration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the-union of the power and energy industries and what is driving the emerging energy economy that is so prevalent today.

The power and energy industries have been experiencing an unprecedented set of challenges that have developed into a 'perfect storm' environment over the past two to three decades; including a continued thirst nationally and globally for increased energy demand based on societal advancement and improved quality of life, coupled with new and uncertain regulatory constraints and environmental pressures, and further stressed by an antiquated and inefficient infrastructure (one that was designed and built over a half century ago under very different market and operating conditions than what exist today). These industries have also significantly lacked technology development, investment, and innovation over the past twenty years. During that time a tremendous workforce and technical talent gap has developed. As we move into the early decades of the 21st century, the aging workforce and limited pipeline of properly trained professionals that rounds-out this unprecedented set of challenges becomes a critical area of focus and need.

But, with challenges come opportunities, and in this newly emerging energy economy the opportunities are vast and diverse. The smart grid is developing as a galvanizing force of dynamic change and advancement for the power and energy sector, and is providing opportunities for technology development and innovation, as well as economic development and job growth. As an example, the advancement and integration of clean energy resources is critical, but must be coordinated with the parallel expansion and modernization of the electric power grid leading to enhanced reliability of energy delivery. Much of this will be enabled through smart grid technology developments and implementation, along with new methodologies and standards, which include greater advances in both utility-scale and micro-scale energy storage technologies. Indeed, clean energy growth, smart grid technology implementation, and energy storage advancements are becoming true 'game changers' in the industry, providing many opportunities.

Thus, while the challenges include a range of needs from technology, infrastructure and R&D, to new policies, workforce, and education, the smart grid revolution has a way of addressing each of these in a proactive manner. How we meet these challenges and create opportunities from them in the decades ahead will have imperative societal, environmental, economic, and global implications; and will set the course of energy sustainability for future generations.

A Sustainability Perspective:

Future research and development trends, as well as needs for progressive education in the power and energy sector, are centering around the confluence of smart grid technology development, demonstration, and implementation in order to enable increased penetration levels and proper integration of clean energy resources, while enhancing energy efficiency throughout the entire energy chain (from consumer to energy provider). Whether it be in the areas of smart and sustainable buildings at the end-use level, transportation electrification growth, power grid expansion and energy storage regulation, or the integration of new resources that bring new challenges and benefits alike, the smart grid is essentially creating a platform for real-time information access, exchange, and interoperability from end-user all the way through to energy producer.

As previously mentioned, this will lead to intelligent consumer decision-making that will in turn drive higher levels of efficiency and conservation throughout the network. This is true at both the centralized bulk power generation and delivery end, as well as at the micro-grid and building level. It is important to recognize that smart grid developments are taking place throughout the network, not just at the end-use level with smart meters and home automation. As an example, development of more efficient power electronics based control systems at the transmission level, in the form of Flexible AC Transmission Systems (FACTS) and High Voltage DC Transmission Systems (HVDC), are leading to improvements in grid reliability and operations. All of this has positive impacts on sustainability in a number of ways – not only in terms of improved system operations, but in how it will enable a change in human behavior towards priorities with respect to resource preservation, energy utilization, and efficiency. Some of this will be based on the ability to plan energy usage through time-of-day economics and needs. By giving the consumer more control over when and how to use energy, and to decide on the economic and other impacts, positive changes can be made towards overall sustainability without sacrificing quality of life.

“By giving the consumer more control over when and how to use energy, and to decide on the economic and other impacts, positive changes can be made towards overall sustainability without sacrificing quality of life”

While some of the concepts of smart grid remain distant in terms of wide-scale implementation, one area of development in which we can begin making a real difference now, as both individuals and institutions, is in the area of energy management and energy efficiency. An impact on energy reduction can be accomplished by adoption of energy efficiency practices at the end-use level. However, smart grid concepts can also provide opportunities for real paradigm shifts leading to significant reductions in energy consumption within the end-use infrastructure itself. For example, certain applications of various enabling technologies can result in advances in building system electrical designs that would greatly improve sustainability for new construction, as well as for renovation and retrofit. In many cases, the sustainability perspective can be advanced through the extended lifetime of existing and future infrastructure.

Eventually, the energy efficiency gains and application of smart grid concepts can lead to technology developments and design that will result in lighter loading within the building; and from there to smaller footprints, weights, and volumes of equipment and materials; and thus, enhanced sustainability in the overall building systems electrical infrastructure and supply. Lifetime extension of certain equipment and subsystems will also lead to sustainability gains, through more efficient operations and reduced maintenance in areas such as power electronics conversions, while limiting complexities and replacements for subcomponents such as inverters, semiconductors, and other elements. Incorporating aspects of automation and diagnostics, for example, will further enhance efficiency and sustainability outcomes. One concept of a smart grid technology integration roadmap directed at the end-user level is shown in Figure 2.

Smart Grid Activities in Pitt’s Power & Energy Initiative:

The University of Pittsburgh’s Power & Energy Initiative is engaged in various smart grid related activities, including both education and research endeavors, based on strong industry collaboration and support. Funded research projects and other activities in the smart grid area are being supported by regional industry leaders such as Eaton Corporation, Westinghouse Electric, Mascaro Construction, and BPL Global, as well as international companies such as ABB and Siemens. Support for other efforts has also come from the Heinz Endowments for program development and the Pennsylvania Ben Franklin Technology Development Authority on future directions in energy research, which have aided Pitt’s efforts in the smart grid. Projects with these companies and constituents includes work on smart grid control methodology developments for energy resource management; advances in electric transmission grid power electronics technologies – FACTS and HVDC; and clean energy integration and grid interface through energy storage regulation.

In addition to the research oriented efforts at Pitt, new curriculum has been developed as part of the electrical

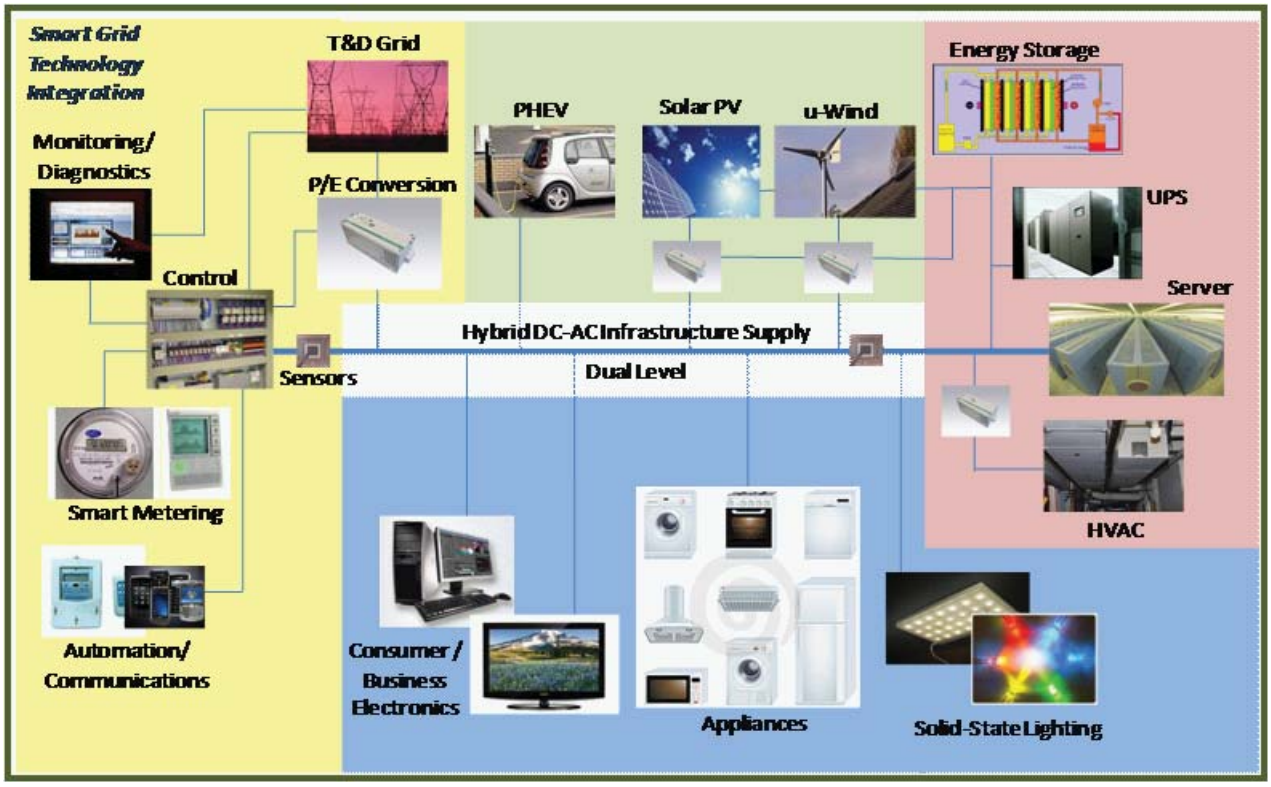

Figure 2 – Smart Grid Technology Integration Roadmap

& computer engineering department's concentration in electric power, and includes courses on smart grids and associated concepts at both the undergraduate and graduate levels. New courses, such as 'Electrical Distribution Engineering and Smart Grids,' introduce students to the concepts and technologies of smart grids and how they are applied throughout the network. Related courses, like the 'Renewable and Alternative Energy Systems' offering, include elements of smart grids as it relates to energy resource integration.

Other regionally based smart grid initiatives include work by the DOE National Energy Technology Lab (NETL), which has also been working on interfacing of power generation with the grid. NETL has recently developed a risk-based approach to assess and plan for adding smart grid technology onto an existing power grid and the capacity to evaluate smart grid options.

On a national level, another organization that is playing a strong leadership role in the smart grid revolution is the IEEE Power & Energy Society (PES). PES recently launched two new technical publications – one on smart grids and another on sustainable energy – and is developing new education and training materials, sponsoring new technical conferences, and advancing standards development activities, all on smart grids.

Future Directions:

As the smart grid revolution leads us further into the advancements of 21st Century technology developments, it will continue to provide future opportunities for business growth, workforce training, and economic impact. The 'smarter' our grid becomes, the smarter we become as a society from a global perspective in preserving our natural resources, protecting the environment, and leading the way for a paradigm shift in energy production and delivery, end-use, and sustainability for future generations to follow. PE

"As the smart grid revolution leads us further into the advancements of 21st Century technology developments, it will continue to provide future opportunities for business growth, workforce training, and economic impact.

About the Author:

Dr. Gregory Reed is Director, Power & Energy Initiative and Associate Professor, Electrical & Computer Engineering Department in the Swanson School of Engineering at the University of Pittsburgh. He is also a governing board member of the IEEE Power & Energy Society.

GREEN BUILDING PRODUCTS

by: Janice Donatelli

The growing interest and demand for greener products, materials and practices are driving the proliferation of environmental standards and labels. This makes it very confusing and nebulous for the public and professional market.

We can start by remembering what sustainability is – paying attention to the lifestyles of our ancestors and how we are affecting future generations. It is valuing the Earth's most precious assets. Air, water and solar are all FREE to its citizens.

Being green used to be about being kind to Mother Earth. Now, it is about saving the Earth. That shift makes any product with sustainable certification a market driver. According to Turner Construction, economic, environmental and social benefits accrue when sustainable design, construction, operation and management principles and practices are incorporated in to building projects. Therefore, just like Leadership in Energy and Environmental Design (LEED®) for buildings, one standard form of certification for products would increase the credibility of green building materials.

For millennia, humans have used materials readily available – stone, clay, mud, wood; and fashioned them to suit their needs. We are becoming increasingly aware of the necessity to reduce our adverse effects on the environment and focus on the renewable and natural materials. Such products are natural plasters, American clay, bamboo and cork. This change creates 'green' jobs by retraining many of our skilled workers.

It also reminds us of the story from William McDonough, co-author of *Cradle to Cradle: Remaking the Way We Make Things* (North Point Press, 2002) about the centuries old Bedouin tent woven from goat's hair. "It does so many things with one simple non-toxic fabric. It provides deep shade in a place with no shade. The black outer surface causes air to move by convective currents creating a cooling breeze. Its coarse open weave allows a beautiful light to permeate the shadow when the sun shines, but swells up tight as a drum when it rains. And you can roll it up and take it with you." McDonough's philosophy is that design should be a force for good.

Neopolitan Plywood Table by PLYBOO

We now live in an age of synthetic resins and plastics. These non-renewable, fossil based raw materials have become a major challenge when it comes to disposal. Research and development through McDonough's and Michael Braungart Life Cycle Assessment (LCA) indicates products can be recycled many times over. The carpet and textile industry have continued to close the loop by using everything – zero waste – nothing goes to the landfill. Is that always the right approach?

The LCA evaluates and discloses the environmental benefits of products over their full commercial cycle, from raw materials extraction to final disposition. We all need to be more vigilant about the raw materials in a 'green' product. We can do this be investigating the Material Scientific Data sheets (MSDS); and if we do not understand the 'green' chemist and the internet research.

Having a certified sustainable product, summary and lineage of the materials can help tell a more accurate story with conviction. For that, we rely upon third party certification of the product. Have you seen the hundreds of 'green' certifications? Some are driven by economic interests. Some are dominated and funded by trade associations or specific industries. All this does is slow the market transformation to sustainability by competing with the higher bar standards and confusing all of us.

This is why it is so important to create a single certification. In the building industry, it is the LEED® standard created by the U.S. Green Building Council (USGBC). Regarding product and technology, the standard is being set by the Institute for Market Transformation to Sustainability (MTS). MTS is a non-profit public charity of leading environmental groups, governments and companies. It has developed and now administers Sustainable Materials Rating Technology (SMaRT©) certifications. MTS is to advance sustainable product standards in an effort to enhance global sustainability and eliminate market confusion and 'greenwash'. It is consensus sustainable product standard, and according to MTS, is applicable to 80 percent of the world's products, including building products, fabric, apparel, textile and flooring[1].

- Rating System: Sustainable Silver, Gold and Platinum
- Multiple environmental, social and economic benefits over the supply chain
- Business benefits: cost savings, design innovation, product differentiation, long term customer relationship, liability reduction
- Market definition of sustainable products
- Life cycle environmental performance requirements for sustainable products
- Social performance requirements for sustainable products over the supply chain
  - Define sustainable agriculture
  - Maximum credit/recognition over all product stages/entire chain for:
  - 100% reduction of over 1300 pollutants covering 12 environmental impacts
  - 100% use of green-e renewable power
  - 100% post consumer recycled or organic/BMP Biobase materials 100% reuse/product reclamation
- Social equity for manufacturer and suppliers

"The quality and value of sustainable products will continue to be questionable until a global standard is in place".

The quality and value of sustainable products will continue to be questionable until a global standard is in place.

Cost is another market driver. There is a front and back end by both the producer and the consumer. Lean manufacturing processes taught us that sound

1 For the full description in PDF of MTS standards, go to http://mts.sustainableproducts.com/standards.htm

-Solatube installed in a Bathroom by SOLATUBE

environmental practices are not just good for the environment, but great for business.

Tim Brown, CEO of IDEO, highlighted a successful corporate approach of producing product. PRESERVE, an American manufacturer of recyclable plastic household products from recycled materials, collaborated with empathetic businesses to recycle as much as possible throughout the life of the product. PRESERVE repurposed

"We need policies in place to bring manufacturing and green jobs back to Pennsylvania"

the plastic from and for Stonyfield Farms and created recycling locations at Whole Foods for the yogurt pots.

An example of unsuccessful, sustainable design was pointed out by William McDonough regarding recycling of PVC (polyvinylchloride) for carpet backing. "PVC has been connected to some of the worst chemical consequences on human and ecological health. Recycling is an important sustainability strategy but recycling the wrong things makes the products perfectly wrong."

Clients have historically wanted products of the best quality, design, performance, value, and presently, those which have the lowest impact on the environment. Social sustainability is the latest approach to surplus asset removal in an environmentally, fiscally and socially responsible manner. Products are coming to the market daily driven by the 'green' dollar. Innovation in design, high performance, sustainability, raw materials to zero waste, indoor air quality, health and safety of the product, cleaning and maintenance are the challenges for tomorrow's creators. Technology changes so rapidly that we must create alternative energies. These are all opportunities for small businesses and job seekers.

One of the biggest obstacles is change in behavior. Purchasing smarter and safer products is a choice. Start with one product, one lifestyle change, one light bulb, and before you know it, you are on a new journey. Your level of awareness and thirst for more knowledge will benefit you, your family and your workplace. It is about creating standards and metrics for developers, architects, builders, homeowners and facility managers to convince others of the benefits of a safe place – interior and exterior.

Some of the favorite products from ARTEMIS Environmental are listed below. Several were also voted TOP 10 Products of 2009 by SUSTAINABLE INDUSTRIES:

- Acadia ec-20
- Inspire Wall
- Plyboo Bamboo Plywood
- Kama Structural Systems
- RainTube
- Separett Villa
- Serious Windows (Pennsylvania Manufacturer)
- Solatube
- Eleek

Of the above, only one of these products are manufactured in Pennsylvania. We need policies in place to bring

Architectural Wall Finishes Binder by American Clay

manufacturing and green jobs back to Pennsylvania. Zero carbon may be the most holistic driver for this to occur. Zero carbon should be pursued as a consequence of how we do business and not about acquiring carbon offsets. How is industry adjusting sourcing, manufacturing, shipping, marketing and other systems?

It is now possible to articulate the following transparent, life cycle and consensus based metrics –

Hardware & Door Handles by ELEEK.

environmental, social and economics benefits criteria. SMaRT has given us a standard leader.

One of the biggest obstacles is change in behavior. The challenge is to do something:

- Reduce waste, including technology
- Increase renewable energy
- Decrease greenhouse gases – even our need to employ waste to energy from landfills
- Increase good recycled content

We all must start by making the best choice possible for ourselves and future generations. A safe and sustainable environment is for everyone – everywhere. PE

About the Author

Janice Webb Donatelli is the owner of ARTEMIS Environmental Building Materials, a wholesale/retail business located in Pittsburgh, PA. She is involved with Green Building Alliance Product Initiative, Sustainable Pittsburgh Business Climate Initiative and Allegheny River Visioning. Janice is an entrepreneur who mentors minority business owners and consults with small business and manufacturers on sustainable practices. Janice continues to do educational outreach and speaking engagements throughout the area.

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~~Spring '10~~	~~**SUSTAINABILITY**~~	~~March 12, 2010~~	~~April 5, 2010~~
Summer '10	**IBC '10 SPECIAL CONFERENCE ISSUE**	May 14, 2010	June 4, 2010
Fall '10	**SMART TECHNOLOGY**	August 27, 2010	September 17, 2010
Winter '10	**BIOMEDICAL ENGINEERING**	November 19, 2010	December 10, 2010

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Spotlight on ESWP Outreach Programs

FUTURE CITY competition

PITTSBURGH

By David Teorsky

This is the first in a series that highlights the student outreach programs presented by the Engineers' Society of Western Pennsylvania (ESWP). This issue will focus on the Future City Competition. Please look for future articles on other ESWP programs in the next issue of the *Pittsburgh ENGINEER*.

For the past 11 years, the Engineers' Society of Western Pennsylvania (ESWP), in partnership with the Carnegie Science Center has presented the Future City Competition in the Pittsburgh Region. Future City is part of the National Engineers' Week® and has been in existence since 1995. The goal of the Future City Competition is to provide a fun and exciting educational engineering program for middle school students that combines a stimulating engineering challenge with a "hands-on" application to present their vision of a city of the future. According to the National Engineers Week web site, Future City "is an integrated, multidisciplinary, holistic approach to relevant issues and is a strong example of STEM (Science, Technology, Engineering, & Mathematics) education that addresses national and state academic content standards."

The program is conducted largely within middle schools from the region. On average, more than 30 schools sponsor a team in the annual event. Teams meet both in- and out- of the classroom, with many hours spent after school. Teams are led by a teacher who functions as the Project Manager for the group. Teams are also assisted by an Engineer Mentor who meets regularly with the group to aid in the design of the project, but also talks about the life of an engineer.

While it is difficult to exactly quantify the number of students involved with Future City since its beginnings in Pittsburgh, "we know that more than 2,500 students have participated within the Pittsburgh regional program directly" on teams, according to ESWP Past President Carl Schwartz (Westinghouse Electric Company) who is credited with bringing Future City to Pittsburgh. There are countless more students that have been involved in the program. Some work on the project as part of the class curricula. In this case, they may have a whole class (or classes) that work as a team on one design. Or, they may break the class up into smaller groups and work on multiple designs. Some teachers work with smaller groups – like the science club – in an after-school environment. The competition employs a team-based approach. In either case, all members of the team have an important role that is necessary for the completion of the project.

Typically, teams meet weekly during the course of the competition, and more frequently as the competition

ACE Mentor Program

ENGINEERS WITHOUT BORDERS USA

DESIGN SQUAD as built on TV

CHAIN REACTION CONTRAPTION

PA eMentoring Online Mentoring for Post-high school Su

FUTURE CITY competition PITTSBURGH

nears. The program starts in September for most teams and culminates in January at the regional competition. Teams begin planning their city of the future with a computer simulation that uses SimCity software. The initial entry into the competition is the computer design, due to the judges in November.

Teams then work on a written essay that is due the following month. The topic of the essay changes with each new competition year, and may address current events that are on the minds of the real life professional engineers. For example, following the nation's 2005 Hurricane Katrina disaster, the essay topic addressed the use of temporary housing for vast amounts of people displaced after a natural disaster. Another theme that included is the use of green materials and sustainable design.

The next step is the construction of a physical model which is made largely from recyclable materials and is under a strict not-to-exceed budget of $100. (Teams are required to submit an expense budget with their models) Creative teams have learned how to fabricate satellite dishes from old CD's, and how to turn a spray-painted 2-litre soda pop bottle into a shimmering high rise condo complex. Each year the Regional competition is held at the Carnegie Music Hall. Models are all displayed and each team makes a 15 minute presentation to a panel of judges on the merits and the design of their city. The students explain to the judges why people would want to live there and what role engineers played in the design and everyday operation of their city. Following the judges review, a rigorous question and answer period follows, with competitors never failing to impress the judges with their preparedness and acuity of the design. This part of the program often creates quite a lasting impression with the judges. Finalist judge Dominick DeSalvo says that "many of these kids are already ready to go to work as project managers, they are so sharp."

Winners of the regional competition go on to the national competition alongside the winners from 30 other regions, on average. The competition is held during National Engineers Week®. Winners receive a week-long trip to Space Camp in Huntsville, AL. In addition to the "main" competition there are a number of special awards given at the regional and national level. (Note: In 2004, the Pittsburgh Regional winner won first place in the National Competition, and was greeted with a front page pictorial on the local newspaper when they returned to the airport.)

The engineer mentor plays a key role in the team's success. Beyond planting a seed on how to approach problem-solving, mentors share real life experience about the career of an engineer. They talk to students about how "they get to travel around the world for work, and let them know that they will not be trapped in a cubicle doing calculations" said Schwartz. Letting them know about what engineers do in government, how engineers work in the medical field with many of the new engineering fields like tissue engineering and biomedical engineering educates students about what a real life engineer does. The best mentors share what will actually occur in the workplace and talks openly about what the various engineering disciplines focus is. Schwartz continues "We hope that mentors impress students with how engineers affect quality of life. We want them to know that engineers do make a difference, and engineers do things that are fun."

Both the teacher and the engineer mentor really stress the soft skills to their teams. Leaders stress the importance of working in teams. "Working with others that you may not have a lot in common with on a personal level, you may come from different backgrounds or different family situations, but that you are able to function together in a team environment is a valuable life lesson" Schwartz went on to say. The lesson is that the "strength of the sum of individuals is greater than the strength of individuals alone, and the biggest lesson is teamwork" said Schwartz.

Another very important reason for the success of Future City in Pittsburgh is the endless volunteer hours contributed by a team of more than 100 volunteers each year. In addition to the team mentor, there are many who work tirelessly on event day. The Pittsburgh region has also benefited from the generosity of our financial sponsors as well. Each year many companies, individuals and technical & professional organizations donate financially to Future City competition.

To learn more about Future City in the Pittsburgh region, visit our website at www.futurecitypittsburgh.org/

PE

Titanic Explorer Discusses Paradigm For Recruiting Next Generation Engineers

By: Chriss Swaney

The stories of the great lost ocean liners and warships – Titanic, Lusitania, Empress of Ireland, Bismarck, Quincy and others – are filled with drama, suspense, romance and tragedy. Today, these fabled ships that lie on the ocean floor comprise an extraordinary underwater museum that has been unlocked by famed underwater explorer Dr. Robert D. Ballard.

Ballard, the keynote speaker at the 2010 Annual Engineering Awards Banquet of the Engineers' Society of Western Pennsylvania February 17 at Heinz Field in Pittsburgh, PA, made headlines around the world when he located the wreck of the titanic in 1985.

Dr. Ballard visits the ESWP's Engineers Building prior to his guest speaking role at the 2010 Annual Banquet

Now, more than two decades later, Ballard is garnering an even greater following for his Jason Project programs that help pique career interest in math, science and engineering for school children nationwide.

During an informal luncheon on February 17 hosted by new ESWP President Deborah Lange, Ballard admonished regional educators and ESWP board members to make learning "fun."

"If you want more youth to sign up for engineering careers you have to put a human face on the discipline,"said Ballard, who recalls getting his first taste of scientific adventure by winning a scholarship from the National Science Foundation to spend a summer at sea.

And his adventures continue. With more than 120 expeditions under his belt, Ballard says he is still fascinated by ancient shipwrecks and the science behind what makes this planet tick.

"Seventy-two percent of the world is under water and that leaves us with so much more to explore and ponder about who we are," said Ballard, a dedicated fly-fisherman and equestrian in his scant spare time.

As founder of the Institute for Exploration in Mystic, Conn., Ballard melds his ongoing research with classroom outreach. A disciple of technology, Ballard stressed the need for engineers to embrace the digital age.

"You must embrace all new technology because that is the best way to reach tomorrow's generation of new explorers, entrepreneurs and inventors," said Ballard.

A maverick who revels in thinking outside the box, Ballard said America needs to rethink how it portrays the important professions of science and engineering to today's youth.

"We have this fixation on stars. But science is not an "I" culture it is a "we" culture. And until we can get this conflict in our culture resolved, we will struggle to entice the best and brightest to important careers in science and engineering," said Ballard. "We must strive to put a human face on the exciting, challenging and critical fields of science and engineering,"

So how does the paradigm shift? Ballard urged both educators and engineers to be more aggressive about recruiting students.

His own recruitment success came in the form of 16,000 letters from school children thrilled by his discovery of the ill-fated Titanic. "What these kids saw was my underwater robots in action, and they wanted to join in the excitement," said Ballard.

"I encourage you to develop a constant learning experience for students and keep their interest by using instructress who are passionate about their careers."And that's just the tack the ESWP plans to follow.

Dr. Robert Ballard meets with ESWP Members

"We are thinking about developing some kind of regional legacy program where students can learn from outstanding professional in their respective fields," said Lange, who is also executive director of Carnegie Mellon University's Steinbrenner Institute for Environmental Education and Research.

"We do mentoring programs throughout our 800-member society, but we want to expand our reach and continue impacting the lives of students from all backgrounds," said Lange. "Engineering is part of our daily lives and we need more people to see and understand that fact."

The 2010 Business of Brownfields Conference

April 19-20-21, 2010
Sheraton Station Square Hotel, Pittsburgh, PA

The Foremost Technical Conference Addressing Brownfields Development

www.eswp.com/brownfields

Schedule at a Glance

MONDAY APRIL 19, 2010		
5-7:00 p.m.	Welcome Reception at the Rivers Casino with Michael Stern	Rivers Casino
TUESDAY APRIL 20, 2010		
7 a.m.-7 p.m.	Registration Desk Open	
7:00-11:00 a.m.	Exhibitor Move-in to the Admiral Room	
8:30-10:00 a.m.	Breakouts: 1A-Overcoming Hurdles to Redevelopment & 1B-Sustainable Concepts in Remediation	
10:00-10:15 a.m.	Networking Break	
10:15-11:30 a.m.	Opening Keynote Session with ULI's Tom Murphy, USGC's Stefanie Young and PA DEP	
11:30 a.m.-6:30 p.m.	Exhibit Hall	
11:30 a.m.-12:30 p.m.	Exhibit Hall Luncheon	
12:30-2:00 p.m.	Breakouts: 2A-Case Studies & 2B-Brownfield Redevelopment and Municipal Authorities	
2:00-2:15 p.m.	Networking Break	
2:15-3:45 p.m.	Breakouts: 3A-Creating New Habitats on Old Brownfields & 3B-Innovative Investigation/Treatment	
4:00-5:00 p.m.	Breakouts 4A-Funding Issues & 4B-Laboratory Considerations	
5:00-6:30 p.m.	Exhibit Hall Reception	
6:40 p.m.	Optional Boat Ride to PNC Park for Pirate Game	Gateway Clipper Docks
7:00 p.m.	Optional Pirate Game at PNC Park	PNC Park
WEDNESDAY APRIL 21, 2010		
7 a.m.-5 p.m.	Registration Desk Open	
8:30 a.m.-1:30 p.m.	Exhibit Hall	
8:30-10:00 a.m.	Breakouts: 5A-Urban Land Redevelopment & 5B-Integrating LEED® Concepts in Brownfields	
10:00-10:30 a.m.	Networking Break	
10:30-11:30 a.m.	PA DEP Keynote Presentation by Secretary John Hanger & SW Regional Director George Jugovic	
11:30 a.m.-12:30 p.m.	Exhibit Hall Luncheon	
12:30-2:00 p.m.	Breakouts: 6A-Success Stories & 6B-Allegheny Riverfront Vision Plan	
2:00 p.m.	Conference Concludes	

*Schedule is subject to change. Please check the BoB website for up to date developments. All events are scheduled at the Sheraton Station Square Hotel unless otherwise noted.

MONDAY, APRIL 19, 2010

5 :00–6 :30 P.M.

Rivers Casino - A Case Study in Riverfront Brownfield Redevelopment
Michael Stern, Strada, Pittsburgh, PA

TUESDAY, APRIL 20, 2010

8 :30–10:00 A.M.

1A Overcoming Hurdles to Redevelopment–A Case Study of Technical, Economic, and Interpersonal Challenges

Sayreville, NJ Site Redevelopment: A Unique and Challenging Brownfields Project
Jonathan Spergel, Manko Gold Katcher & Fox, Bala Cynwyd, PA

1B Sustainable Concepts in Remediation

Sustainability of Groundwater Remedies in a Technical Impracticability Demonstration
William Ahlert, HDR Engineering, Inc., Bethlehem, PA

Sustainable Construction Practices Incorporated into Award-Winning Lagoon Closure
Steve Kretschman, WSP Environment & Energy, Pittsburgh, PA

Main Street Brownfield Remediation/Sustainable Development
Richard Cartwright, MECX, East Amherst, NY

10:15–11:30 A.M.

Opening Keynote Session
Conference Chair Mark Urbassik introduces speaker Troy Conrad and Denise Brinley of the Pennsylvania DEP; and Stefanie Young of the U.S. Green Building Council, followed by a Keynote Presentation from Former City of Pittsburgh Mayor Tom Murphy, now a Fellow with the Urban Land Institute, Washington, D.C.

12:30–2 :00 P.M.

2A Lessons Learned from Case Studies

Brownfields in the Bankrupt Automotive Sector
Brad White, Hull & Associates, Inc., Pittsburgh, PA

Crucial Agency Negotiations for Brownfield NFA
James Peyton, Michael Baker Jr., Inc., Crown Point, IN

Redeveloping Brownfields for Commercial, Retail or Mixed-Use Site: A Success Story in our Region
Dave French, L.R. Kimball, Coraopolis, PA

2B Brownfield Redevelopment and Municipal/ Redevelopment Authorities

The Role of Redevelopment and Other Municipal Authorities in Brownfields Redevelopment
Steven Miano, Hangley Aronchick Segal & Pudlin, Philadelphia, PA

2 :15–3 :45 P.M.

3A Creating New Habitats on Old Brownfields

Creating New Habitats on Old Brownfields–Engineering Controls and Ecological Processes
Tracey Vernon, Land Use Consultant, LLC; Jill Gaito, Green Center of Central PA, Harrisburg, PA; Sean Garrigan, Stomberg/ Garrigan and Associates, Inc.; Jennifer Dowdell, Biohabitats, Inc.

3B Innovative Investigation/Treatment

Mitigation of Vapor Intrusion Risks: Passive Wind Turbine System
Dhruv Raina, WSP Environment & Energy, Pittsburgh, PA

Multi-Phase Approach to Investigating a TCE Plume in a Karst Setting
Mary Washko, Groundwater & Environmental Services, Inc., Warrendale, PA

Use of a Permeable Reactive Barrier Wall for Treatment of a TCE Plume, Red River Army Depot, Texarkana, TX
Marilyn Zumbro, KEMRON Environmental Services, Inc., Marietta, OH

Innovative Approaches for Effective Reductive Dechlorination
Vincent Ou, Ph.D., P.E., American Geosciences, Inc., Murrysville, PA

4 :00–5 :00 P.M.

4A Funding Issues

Brownfields and Tax Increment Financing
Evans Paull, Redevelopment Economics, Baltimore, MD

Brownfield Partnering to Achieve Success
Nathan Strum, Allegheny County Economic Development, Pittsburgh, PA

Economic and Environmental Benefits of Brownfields Redevelopment
Evans Paull, Redevelopment Economics, Baltimore, MD

4B Laboratory Considerations

TestAmerica Dissects the Frequency of Detections on Method Blank Analysis
David Miller, TestAmerica Laboratories, Inc., Pittsburgh, PA

Better Decision Making through SEM/EDS Speciation of Inorganic Contaminants at Brownfield Sites.
Ryan Hall, RJ Lee Group, Monroeville, PA

WEDNESDAY, APRIL 21, 2010

8 :30–10:00 A.M.

5A Urban Land Redevelopment

Sustainable Benefits of Urban Farming as a Potential Brownfields Remedy
Richard Hoff, The Mahfood Group, LLC, Bridgeville, PA

Integrating Beneficial End-Use with Site Remediation Strategies
Brian Clemson, CLA, PP, Hatch Mott MacDonald, Pittsburgh, PA

A Brownfield Neighborhood Thinks Green
Malik Bankston, The Kingsley Center, Pittsburgh, PA

5B Integrating LEED Concepts in Brownfields

Life Cycle Analysis of Residential Brownfield & Greenfield Developments: A Case Study of Summerset (Phase 1) in Pittsburgh PA
Ronell Auld, Carnegie Mellon University, Pittsburgh, PA

Commuting from US Brownfield and Greenfield Residential Development Neighborhoods
Amy Nagengast, Carnegie Mellon University, Pittsburgh, PA

10:30–11:30 A.M.

Opening Keynote Session
PA DEP Secretary John Hanger discusses the DEP Brownfields Program

12:30–2 :00 P.M.

6A Success Stories

Stackpole Industrial Complex Redevelopment, St Marys, PA
Gary Hoover, L. Robert Kimball & Assoc., Inc, Ebensburg, PA

Raymark Industries/Manheim Redevelopment Site
Justin Lauterbach, RT Environmental Services, Inc., King of Prussia, PA

6B Allegheny Riverfront Vision Plan

Allegheny Riverfront Vision Plan: A Different Look at Brownfields
Stephen Quick FAIA, Perkins Eastman Architects, Pittsburgh, PA; Rob Stephany, Urban Redevelopment Authority of Pittsburgh, Pittsburgh, PA; Stefani Danes, AIA, LEED AP, Perkins Eastman Architects, Pittsburgh, PA

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