More Than a Buzzword
The Business Case for Quantifying Sustainability
When Getting Correct Information is Essential

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November 2, 2009, marked the beginning of a new era for our Association.

That was the first day on the job for Jim Gephart, our new Chief Information Officer (CIO). CIOs are not common in associations of our size, but you have all told us that we have some “special needs” in this area: better member service systems, more robust Web features, new online product delivery tools, and more. None of this will come overnight, but Jim definitely has his marching orders and a huge undertaking ahead of him!

Jim’s placement is the result of an enormous amount of work by staff and volunteers. Of particular note is the guiding hand of A&WMA’s Information Technology Task Force, chaired by President-Elect A. Gwen Eklund. She assembled an extraordinary group of experts for the Task Force: Chad Blevins, Environmental Program Coordinator, University of Texas System; Jill Barson Gilbert, President and CEO, Lexicon Systems LLC; Howard Saxion, Vice President, CH2M HILL; Patricia A. Brush, Director HSE and Security, Air Liquid Process & Construction North America; and Richard J. Tropp, Associate Research Professor, Desert Research Institute.

As CIO, Jim will also be responsible for the Association’s financial operations. He and our new Executive Director will be expected to implement new and improved financial processes to better evaluate the investment of time and money, and which are not common in associations of our size, but you have all told us that we have some “special needs” in this area: better member service systems, more robust Web features, new online product delivery tools, and more. None of this will come overnight, but Jim definitely has his marching orders and a huge undertaking ahead of him!

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The goal of CIOs is that the Association’s financial operations are efficiently and effectively managed. This will require a new focus on financial management tools, and more. None of this will come overnight, but Jim definitely has his marching orders and a huge undertaking ahead of him!

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As I began this year as President, my goals were to enhance A&WMA’s international stature and strengthen our partnership with regulators. Clearly, the economy (or lack thereof) and the change in Association leadership have monopolized the Board’s agenda. Nonetheless, there has been progress on both fronts…thanks to the work of others and little more than cheerleading from me.

Internationally, two major events next year promise to ensure strong North American diversity: A&WMA’s 103rd Annual Conference & Exhibition in Calgary in June and the 15th IUAPPA World Clean Air Congress in Vancouver in September (which A&WMA is hosting). Add to these the International Specialty Conference on Air Quality Management to be held in Xi’an, China in May—and that our China Chapter is rapidly growing to a Section—and all are very encouraging developments.

In the United States, with the Obama Administration’s focus on environmental issues, especially climate change, significant new environmental programs are being put in place, including the proposed greenhouse gas (GHG) reporting rule and Title V GHG “tailoring” rule. A&WMA has traditionally played a pivotal role in technical and regulatory training during the rollout of new regulations. We foresee a strong role for the Association in this area in 2010 and beyond.

Looking back at this year, there is one part of being your President that stands out above all else…visiting Sections and Chapters. My only regret is that I had to pass up some opportunities because of scheduling conflicts. There are so many great programs out there! Impressive minds and leaders I’d never before met. And everywhere I went, I found excited young professionals ready to carry the work of others and little more than cheerleading from me.

As with all great institutions, A&WMA’s strength is in our many individuals and their ideas. It has been an honor to serve and to know that we have a bright future ahead under President-Elect, Gwen Eklund.

Thank you all…and adieu.
Join the Air & Waste Management Association in Calgary for our 103rd Annual Conference & Exhibition (ACE) and discover the latest in environmental innovation, re-establish your professional relationships, and stay ahead of the game—all while having some fun at ACE 2010!

ACE 2010 will feature a technical program boasting over 500 speakers, the Critical Review—"Multipollutant Air Quality Management: Prospects for the Future," hundreds of exhibitors displaying the newest products and services, social tours and networking events, and professional development courses taught by leading instructors.

www.awma.org/ACE2010
Using an Environmental Management System to Develop and Implement a Sustainability Program

Sustainability is not just a buzzword for companies to say they are “going green,” it is now widely understood to be an effective business practice that can positively influence the environment and save money. The difficulty in implementing a sustainability program is finding appropriate resources and identifying and setting priorities consistent with an organization’s environmental policy.

Developing a Formal Sustainability Program

Starting a sustainability program from scratch can be a challenging process, especially for organizations without a structured environmental management framework in place. Organizations that have already implemented an environmental management system (EMS), should have the necessary management framework, shared commitment, and programs to successfully implement a sustainability program without much additional effort. There are many reasons for a company to develop a formal sustainability program. A company using sustainable business practices will reduce their impact to the environment, improve employee and community relations, and save money. The program can also be used to market a company’s products and services to environmentally conscious parties.

Sustainability is generally defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” A sustainability program generally encompasses several of the following areas: greenhouse gas (GHG) inventory/carbon footprint, energy management, water savings, transportation, sourcing and recycling, stormwater management, and sustainable design. This covers most, if not all, of a company’s operations and, as such, requires the input and cooperation of a wide array of people throughout the organization for a sustainability program to be effective.

An EMS, especially one that conforms to the ISO 14001:2004 Standard, can assist sustainability efforts by providing a structured program to clearly define responsibilities, objectives, and procedures. The environmental policy at the heart of an EMS should help frame a sustainability policy and communicate the policy to all interested parties, both internal and external. Having an EMS in place will help determine sustainability goals, develop applicable procedures, outline a clear path for allocating resources, and provide a method for documenting and tracking improvements.

Implementation Steps for Success

Many EMSs are implemented by organizations seeking to more effectively maintain compliance with environmental regulations and other requirements. Additional benefits of an effective EMS include the broadened environmental awareness throughout the organization’s top management, employees, and those working on its behalf consistent with the organization’s environmental policy and significant environmental aspects and
Starting a sustainability program from scratch can be a challenging process.
impacts. An ISO 14001-conforming EMS is expected to show continual improvement using a “plan, do, check, act” model. These elements are fundamental actions of a successful sustainability program.

**Management Support**
Management support is necessary for any successful program, and it is no different for a sustainability program. Since it is integral to every portion of a business, a sustainability program requires the cooperation of all employees. Top management can demonstrate a commitment to the environment by publishing a policy on sustainability and providing necessary resources for implementation. Management participation is essential when setting and reviewing goals, allocating resources for the program, and continually monitoring progress. Similarly, management review is a major requirement of an ISO 14001-conforming EMS.

**Effective Communication and Training**
Once the foundation for a sustainability program is in place, an organization must embark upon communication and training programs in order to implement the program properly. A program design can look good on paper, but until employees learn about the program, understand it, and embrace it, the program will not succeed. The cornerstone of an effective EMS is an organized training process that effectively communicates the company’s environmental policy, significant aspects and impacts, objectives and targets, and pollution prevention efforts.

An example of this would be a recycling program, which on the surface would appear easy to implement. All you have to do is place a few recycling bins where people can see them, and then everyone will be recycling, right? In reality, it is much more difficult. Employees must all be aware that the bins are available and where they are located. The types of recyclable materials that can be placed in the bins must be properly communicated. If, for example, there is confusion over which types of paper are allowed in the bins, often none is recycled. Employees must be educated on why recycling is beneficial both to the company and the environment. Educating employees increases the likelihood of success.

**Standard Operating Procedures**
Additionally, as part of the EMS, standard operating procedures (SOPs) should be developed. SOPs provide guidance on how to perform duties necessary to achieve continual environmental improvement. One of the SOPs developed should be for communication. A formal communication procedure will keep employees informed about any changes made to the sustainability program and provide a method for employees to give feedback on ways to improve the program. Open communication allows for employees to become actively involved and engaged in a program, rather than just being told what to do.

**An Aspects and Impacts Analysis**
A major step in developing an EMS is to complete an aspects and impacts analysis. An environmental aspect is defined in ISO 14001 as an element of an organization’s activities or products or services that can interact with the environment; and an environmental impact is defined as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects.²

An aspects and impacts analysis is performed for all of a facility’s operations with a critical eye toward operations that may have an environmental impact. The resulting aspects and impacts will also help in developing a sustainability program. This type of analysis can also discover items that may otherwise be overlooked. A manufacturing plant, for example, has processes and operations that probably have fairly obvious potential environmental impacts (e.g., air and water emissions). If a large office building is associated with the plant, however, the resulting environmental impacts from these operations could be overlooked. An aspects and impacts analysis may highlight high electricity usage (aspect) at the office building, resulting in high GHG emissions from electricity generation (impact), or a large amount of office waste (aspect) that causes resource depletion from trees used to make paper (impact). Improving these areas can provide significant reductions in environmental impact and operating cost.

An ISO 14001-conforming EMS will subjectively rank the facility environmental aspects to determine the most significant. Appropriate operational controls can then be implemented to eliminate the aspects, reduce their impact on the environment, or more efficiently manage them. The controls may
include pollution control equipment, process controls, and procedural changes (both written and unwritten). With careful selection of processes/procedures, operational controls can serve both EMS and sustainability programs simultaneously.

**Monitoring and Measurement**

Monitoring and measurement is another important component of an EMS that can aid a sustainability program. Tracking progress helps demonstrate that the program is having a positive effect. These results can then be communicated to employees and stakeholders to show that the facility is truly achieving continual improvement.

The relationship between an EMS and a sustainability program can also be symbiotic. The goals identified in the sustainability program should feed the objectives and targets of an EMS, which is the lifeblood for a mature system to demonstrate continual improvement to third-party auditors.

Likewise, the policies, procedures, and actions that become the foundation of the sustainability program will become “other requirements” that an organization must check in a prescribed timeline. While not required, it is often beneficial for an organization to outsource this function to a consultant for objectivity and completeness. A maturing system needs a continual supply of new ideas and best management practice recommendations to grow and improve.

**Conclusions**

Whether an EMS is already in existence or is developed during the creation of a sustainability program, it can be a valuable tool to ensure that a sustainability program is successful. As with an EMS, a sustainability program is not static; it is an ongoing program that should continue to evolve and improve. Thus, using the idea of an EMS as a continual improvement cycle will help make your sustainability program...sustainable. em

**References**

Environmental sustainability is an aspiration, rather than a goal with a finite end. No organization will reach a point when they can say, “OK, we’ve arrived—we’re sustainable.” Much like Operational Excellence or Six Sigma programs, there will always be room for continual improvement.

Sustainability programs are driven by the desire to address the global challenges of climate change, resource scarcity, pollution, and toxicity related to an organization’s products, services, operations, and supply chain. Sustainability leaders look at these challenges as opportunities to ignite business innovation while simultaneously meeting compliance and social responsibility objectives. However, environmental and business results can be hard to measure.

Baselines and annual progress toward goals can be measured, though not that easily, especially if done manually. Without integrating a sustainability data program into business operations, organizations will have a tough time gathering, analyzing, and reporting the data. Also, a lack of near real-time data makes it difficult for an organization to chart their course, relying on historical data will only allow an organization to compare performance to goals after the fact.

Organizations quickly find that the only path to continual improvement is to invest in the correct information technology (IT) tools that will assess, analyze, and act on sustainability project improvements in near real-time frequency. IT systems for sustainability are evolving very quickly. Not all
IT systems are created equal, particularly those with the ability to drive daily processes that enable a business to meet its quarterly and annual goals.

When considering an IT system to drive sustainability performance management, organizations need to go beyond simple measurement to set up the infrastructure for achieving their goals. There are four key considerations to enable a sustainability performance management program:

1. **Granularity**: Enterprise metrics versus asset-level accounting
2. **Scope**: Greenhouse gas emissions only versus integrated environmental management
3. **Frequency**: Annual reporting versus real-time measurement
4. **Expandability**: Siloed versus modular, integrated approach

### Granularity

Greenhouse gas (GHG) emissions, proxied by carbon dioxide equivalent (CO₂e) emissions, is currently the hot topic for businesses. With new reporting rules pending in the United States, many businesses have performed a rough estimate of corporate GHG emissions, which often involve a time-intensive manual process to gather and analyze data. When doing manual data aggregation, organizations have found that GHG data were not readily available throughout the organization, and certainly not at the operating asset or equipment level.

Complex and sophisticated organizations now realize that, like other air emissions regulated under the U.S. Clean Air Act, they need to measure carbon at an asset or operating equipment level. This is necessary because the information must be specific to the industrial process, including required complex calculations, and it must be fully traceable. Further, if an organization wishes to manage carbon to its corporate and regulatory goals while optimizing operations, analysis must be done at an operating source level. By this, we mean that emissions are measured and managed at a discrete emission source level (e.g., boiler) and then aggregated to higher (e.g., site, business unit, corporate) levels, rather than simply making gross estimates at the higher level.

Table 1 outlines several key differences among methods used to manage the measurement of carbon as a metric versus carbon as an asset. The monetization of CO₂e emissions, particularly for those organizations with significant Scope 1 direct emissions (i.e., from sources owned or controlled by that organization), drives adoption of emissions accounting practices, rather than rough estimates.

From an optimization standpoint, as goals are put in place and real-time operations occur, asset-based information provides the greatest flexibility. With this, granular data adjustments can be designed and implemented into real-time systems, specific processes, and distinct production assets, allowing measurement and performance, rather than measurement alone. Figure 1 highlights how an asset-based approach can be leveraged to optimize the financial aspects of carbon emissions.

Investing in IT that only offers corporate-, facility-, or cost-center level measurement and then attempts to move to asset-level information will produce significant inconsistencies and challenges. Processes and systems should be architected according to operational realities and compliance requirements from the beginning—it is a significant effort to change in midstream.

### Scope

GHG emissions relate to many different operational and environmental issues, and changing one environmental impact affects several others. Thus, justifying the need for an integrated system that takes all of this into account. What we suggest is a holistic, enterprise-wide approach to GHG accounting, using a solid IT infrastructure.

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**Table 1. Carbon as a metric vs. carbon as an asset.**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Carbon as a Metric</th>
<th>Carbon as an Asset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reporting</td>
<td>Annual</td>
<td>Near real time (monthly minimum)</td>
</tr>
<tr>
<td>GHG Methodology</td>
<td>Convenient, historical practice</td>
<td>Regulatory/program required</td>
</tr>
<tr>
<td>Data Granularity</td>
<td>Aggregate</td>
<td>Asset (source), process, product specific</td>
</tr>
<tr>
<td>Data Quality</td>
<td>Best available</td>
<td>Mandatory validation and substitution rules</td>
</tr>
<tr>
<td>Verification</td>
<td>Optional</td>
<td>Required</td>
</tr>
<tr>
<td>Management</td>
<td>Distributed, currently available systems</td>
<td>Centralized, standardized platform</td>
</tr>
</tbody>
</table>
Carbon, the issue of the day, is driven by a number of other linked factors. For example, because pumping water is one of the largest industrial uses of energy, water efficiency equals energy efficiency. In California, water transportation, storage, and treatment accounts for approximately 19% of the state’s electricity usage.1 Similarly, waste reduction at the source reduces the amount of energy required for disposal or recycling.

Stakeholders, including customers, nongovernmental organizations, media, and investors are interested not only in climate impacts, but in broader sustainability impacts, opportunities, and liabilities. They are typically also interested in an organization’s waste reduction strategies (and the cost savings thereof), water efficiency and effluent strategies (and the cost and liability savings thereof), health and safety impacts on employees and the broader community in which the entity operates (and the cost savings and brand impact thereof), materials safety (and liability and marketability of product thereof), and product development opportunity (and the revenue growth and shareholder value thereof).

While some organizations new to environmental management as a business opportunity are starting with GHGs, those with commitments to innovation and cost reductions created by sustainability see this as a broader, interconnected issue. Therefore, it is a benefit to seek processes and systems that can scale to broader issues—even if the organization isn’t implementing them today.

**Frequency**

In a 2009 IBM survey, Jeff Hittner IBM’s corporate social responsibility consulting leader, revealed an “optimization gap” between recognizing the need to do things like cut energy use and make more environmentally friendly products, and actually having the information to do it. “Everyone’s going out and putting forth these new goals,” Hittner said. But less than a third of companies were collecting data frequently enough to make strategic decisions, which to IBM is once per week or more.2

Companies that rely on annual reporting of sustainability are unable to make strategic decisions, since they are always looking in the rear-view mirror. It takes more real-time data to enable a strategic view. This is achieved by integrating the environment, health, and safety management information system (EH&S-MIS) with real-time, source-based data coming directly from process historians such as OSI Soft PI or asset and work management systems such as IBM Maximo, which are essential for organizations in complex industries.

When integrating an environmental system with process data systems, data are in sync regardless of reporting, operational purpose, or focus. This is extremely important, as there is significant risk associated with mismatched data for compliance, audit, trading, and accounting assurance. Integration ensures that all systems use the same master source—resulting in a single version of the truth.

Integration with process systems means there is no “fire drill” at reporting time—the data are simply there, calculated correctly, and at an organization’s disposal for analysis and forecasting. This avoids the ongoing expense of manually gathering, verifying, and rolling up data for ad-hoc, periodic, or regular reporting and analysis. An increasing number of companies are moving in that direction, including Duke Energy with its “e-TRAC” solution, using ESS Essential Suite as the foundation. Duke’s solution employs substantial integration between the consolidated EH&S-MIS solution and other systems.3 Integration points for this enterprise-wide solution include air emissions, process safety, chemical inventory/material safety data sheets (MSDS), audits, compliance management, and incident management.
As a book-end on this point, the Aberdeen Group found in 2009 that “Best-in-class (sustainability performers) are three times as likely as laggards to have real-time visibility into sustainability conformance across the value chain.” This has many benefits—including the reduction of manual effort and rework, allowing traceability and accuracy of data and integrating an organization’s environmental data into production processes.

**Expandability**

Choosing an enterprise sustainability IT solution is a decision for which one should “measure twice and cut once.” Without careful consideration of long-term requirements, an organization risks propagating multiple point-source solutions to address different functional areas (e.g., GHGs, waste management, chemical data handling, fresh water consumption and process water discharge, incident management, industrial hygiene, social commitment tracking). It is important to understand enterprise-wide requirements and manage them from cradle-to-grave. An effective requirements management process can help identify and mitigate risk factors to ensure an organization’s systems initiative becomes a success.

Taking a holistic approach to sustainability, addressing EH&S and community performance measurement in one integrated system creates the most value. PetroChina, ranked by Forbes as the 14th largest public company in the world, is an excellent example of a major international company successfully implementing an integrated approach to sustainability information management. By addressing all areas in one integrated application, including environment (air, water, waste, energy), safety (accident, incident, hazardous materials), and health (occupational hazards, industrial hygiene), PetroChina cut training costs and greatly reduced the number of systems that its IT department needed to maintain. The results of the integrated approach are telling. According to Gartner, implementation of EH&S software as part of a major business management and IT initiative helped PetroChina cut the rate of deaths caused by accidents by a factor of 10 and the overall accident rate by a factor of five in five years.

With a long-term integration approach in mind, companies can still implement a modular solution matching business needs with functionality. For example, if the IT solution for GHGs, incident management, or another topic can be funded first, other modules may be added on later. On the other hand, if different siloed, nonintegrated solutions are acquired from different vendors on different technology platforms, the vision of a unified sustainability IT platform will be difficult to achieve.

**Conclusions**

Making the right decisions in these four areas—granularity, scope, frequency, and expandability—will set up a sustainability IT program for long-term success. The right system ensures that business analyses are credible and accurate (essential when linked to financials for trading, performance analysis, and forecasting), and it helps to meet any compliance requirements.

There is no “one size fits all” solution for sustainability performance management. In all cases, systems should be evaluated on their ability to integrate into the core business of an organization, rather than as a one-off tool. Depending on its operational and compliance requirements, an organization will also need to ensure that its systems, and the consultants that implement them, have experience meeting complex EH&S compliance requirements within its industry. If infrastructure is designed at the appropriate level of detail, any organization will have the flexibility to meet demands and deliver essential data for many years to come.

**References**

by Caroline Conway

Caroline Conway works with a variety of corporate functions to define and implement sustainability strategies that produce competitive advantage for businesses and their customers. E-mail: carolinecconway@gmail.com

INTEGRATING Environmental Assessment into Product Development

Assessing the environmental performance of industrial processes is an established activity at most manufacturing companies. However, many of the broader environmental impacts attributable to a company are defined during the conceptualization and development of its products. Incorporating product-based environmental assessment into these activities can help companies achieve new levels of sustainable innovation.
In recent years, a business case has emerged for the use of life cycle assessment (LCA) to inform product development based on comprehensive environmental data. Providing product developers with LCA-based tools can help them improve environmental performance while achieving other aspects of functionality. However, usability, data collection, and the quality of assessment results must be considered when attempting this integration. This article considers the opportunities and challenges of this approach.

**Product- vs. Process-Based Assessment**

The process-based approach to environmental assessment has been an essential part of doing business ever since regulations started driving corporate environmental management. Assessing impacts from this perspective provides valuable guidance in minimizing waste, using resources efficiently, and reducing emissions to air, water, and soil. However, a company’s impacts extend beyond its four walls to suppliers, customer use of its products, and product disposal at the end of life.

Assessing the life cycle impacts of products gives companies a comprehensive picture of where to focus improvement efforts. For example, consumer packaging manufacturers may find that product impacts can be reduced through material substitution; whereas electronics manufacturers may find that use phase impacts warrant more emphasis on design for energy efficiency; and material producers may find that ensuring the recyclability of product far outweighs initial production impacts. Conducting product-based LCAs reframes corporate environmental priorities based on these broader impacts.

LCAs for completed products are already used to set strategic priorities for some companies, however, many opportunities to improve performance are found in the details of new product development. Material choices can largely determine the environmental footprint of a product, energy efficiency is almost entirely driven by early stage design, and product assembly configurations can dictate recovery at the end of product life. When product developers have access to life cycle impact data, they are better equipped to make educated choices that maximize the total environmental benefit of products.

**The Business Case for Product-Based Assessment**

A strong business case for product-based assessment has emerged in recent years due to the changing landscape of environmental drivers for industrial companies. Customer demands for environmental information, the opportunity to mitigate costs and risks, and emerging regulations that impact entire supply chains are playing increasingly interrelated roles as drivers for product-based environmental improvement (see Figure 1).

Emerging consumer and business-to-business demands for environmental performance can significantly impact a company’s bottom line. While consumer demand has been cyclical, there is evidence that a subset of consumers has consistent interest in the environmental performance of the products they buy. In recent years, the number of eco-labels vying to become the standard for product-based environmental performance across products or in specific industries has proliferated. For upstream producers, this is further magnified by new business-to-business demands for environmental improvement.

Cost reduction opportunities have long been associated with efficient material use. But some
companies are exploring more sophisticated methods to reduce costs throughout the supply chain, product use, and end of life. This is driven, in part, by concerns about long-term resource availability, but is immediately linked to anticipated carbon costs throughout the supply chain and recycling regulations at the end of life. Similarly, mitigating toxicity and other environmental risks during customer use and material recovery are driving material selection and design for life cycle management initiatives.

Equally significant is compliance with product-based regulations. The impact of these regulations is most visible in Europe where Restriction on Hazardous Substances (RoHS), Waste Electrical and Electronic Equipment (WEEE), and other initiatives have pushed companies to improve their upstream material choices and downstream product recovery activities. Product-based regulation in North America is gaining renewed momentum, particularly regarding end of life producer responsibility for packaged goods and electronics. Further regulatory developments are anticipated with the EU EcoLabel, integration of product labeling into proposed North American carbon regulations, and efforts by industry coalitions to develop consensus standards pointing toward more stringent environmental standards for products.

To take advantage of these business opportunities, a company must be able to assess the full impacts of its products throughout the life cycle. In doing so, it becomes possible to determine where compliance efforts should be focused, reduce costs and risks, and offer innovative value propositions to downstream customers.

Integration with Product Development

Accounting for these demands ensures optimization of performance up front and avoids potential costs of redesigning products after initial development. As a result, product developers are increasingly tasked with integrating environmental impact assessment into their decision-making processes.

LCA provides a framework for comprehensive assessment of environmental impacts and accurate identification of improvement priorities. However, development teams responsible for many aspects of product functionality are frequently not equipped with the expertise or time to perform a complete LCA. This is particularly the case for products with intricate material and performance requirements and rapid development cycles. In addition, when a full LCA is completed by experts after products are developed, it is not always possible for developers to act on the results.

“Design for environment” tools are intended to help nonexperts integrate environmental assessment into their activities during early-stage product development. These include design and material guidelines, certification criteria, and stage gate reviews by environmental experts. These tools can be used in concert with each other or at different stages of product development. They play an important role in building up environmental expertise within product development teams. However, they lack the comprehensive assessment of impacts required to make sophisticated design decisions that maximize environmental and business opportunities.

A Product Development LCA Tool: Lessons Learned

Ideally, the comprehensive nature of LCA can be made accessible to product developers with the immediacy and usability of “design for environment.” Several questions must be answered to provide an accessible tool for product developers. The first is

![Figure 2. Environmental data inputs into product-based environmental profiles.](image-url)
whether it is feasible to estimate life cycle impacts before product features and materials are fully defined. If this can be achieved, additional questions of how to achieve data quality and usability, integrate the tool with existing systems, and leverage environmental management expertise must be addressed.

An early version of an LCA tool for product developers illustrates the opportunities to drive better decision making and the challenges in creating an LCA-based process for product developers. This tool was developed for Steelcase, a global durable goods manufacturer (www.steelcase.com), and was tested over the course of a year. It included building the tool into existing LCA software, usability tests, identification of data collection and management procedures, and product tests to determine accuracy at each stage of product development.

Accuracy of Results
The fundamental value of an early-stage LCA tool is defined by the accuracy of environmental performance data at each stage product development. To test this concept, three of Steelcase’s products with diverse functions were assessed based on known product elements at each stage of development (see Table 1). The benchmark performance target was the company’s existing targets for cost estimate accuracy during development. Ideally, representation of environmental impacts would follow a similar pattern of increasing accuracy.

On average, the degree of accuracy was promising. While there was some variation across the products, average estimates of final impacts closely mirrored cost estimate accuracy targets. Where accuracy was not up to expectations, the identified cause was low quality environmental data for certain materials rather than a lack of information about product inputs and outputs.

This assessment indicated a strong case for data-driven assessment in product development. However, accuracy ultimately depends on the availability of high-quality environmental data.

Data Development
Accurate environmental impact data for materials, processes, transportation, customer use, and end of life disposal or recovery are the fundamental inputs of product-based environmental assessment (see Figure 2). Because impacts vary within and
across industries, the most accurate data come from the company itself and its supply chain. However, collecting these data can incur significant costs, and in the conceptual and design stages of development, industry average data are of value when specific suppliers and facilities have not yet been identified (see Table 2).

Industry average and generic data most useful in the first stages of product development exist for a wide variety of materials and processes. However, data quality varies widely. In the long term, regulatory and standard development efforts will be needed to drive consistency across reporting of industry data. In the short term, corporate environmental experts will need to pay close attention to the assumptions and methodologies underlying external data.

Company-specific data present different challenges. Supplier participation can be limited due to concerns about ulterior motivations for data collection. Targeting strategic suppliers rather than attempting full compliance and ensuring data confidentiality can increase participation, as well as guaranteeing appropriate use of these data. For internal processes, allocation of process data to products is required. In some areas, direct measurement can facilitate this effort. However, where this cannot be implemented, cost accounting allocation methods can be used as a template to start allocating environmental impacts.

Supply chain, operations, and information technology representatives inevitably need to be involved in determining the structure and extent of data collection at each level of data. They must also be heavily involved in data system development and maintenance. At present, data quality presents the most significant challenge for the use of LCA in product development, and the engagement of all affected groups is necessary to overcome this hurdle.

**Usability**

The tool was tested with representatives from a number of Steelcase’s divisions. In general, the response was positive, though several interface

| Table 1. Product development stages and relative accuracy of environmental data. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Stage**       | **Activities**  | **Known Product Elements** | **Cost Accuracy Targets** | **Tested Environmental Accuracy** |
| Concept         | Feasibility of a concept is explored based on market research and material explorations. | Primary materials in the product, represented by generic data | No cost estimates | Within 44% of final impacts |
| Design          | A concept with development potential moves into design where several iterations are developed and compared. | Major components and materials in the product, represented by a combination of generic and specific data | Within +/- 30% of final costs | Within 35% of final impacts |
| Engineering     | The iteration that best meets cost, marketing, and other requirements is developed with functional, material and structural decisions fully developed. | All components and materials, represented by specific data | Within +/- 15% of final costs | Within 22% of final impacts |
| Process         | The engineered product is completed and process / supply chain decisions are made to initiate production. | Addition of processes and packaging to the product profile | Within +/- 10% of final costs | Within 4% of final impacts |
| Reporting       | Reporting provides lessons learned for future products. Public reporting on environmental performance is also conducted at this point. | Full product inputs and outputs represented by the previously conducted LCAs for each product | 100% of costs represented | 100% of impacts represented |

When product developers have access to life cycle impact data, they are better equipped to make educated choices that maximize the total environmental benefit of products.
Table 2. Data needs at each stage of product development.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Material Data Needs</th>
<th>Process Data Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>Generic data</td>
<td>Generic data</td>
</tr>
<tr>
<td>Design</td>
<td>Specific (supplier average)</td>
<td>Generic data</td>
</tr>
<tr>
<td>Engineering</td>
<td>Specific (single supplier)</td>
<td>Specific (company process)</td>
</tr>
<tr>
<td>Process</td>
<td>Specific (single supplier)</td>
<td>Specific (company process)</td>
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</table>

usability improvements were identified through the testing process. However, the most significant finding was very different sets of needs depending on the structure of each group, their product development scope and cycle, and their access to environmental expertise.

One division had a large number of product developers and limited access to environmental resources. A second had fewer developers, but more frequent contact with environmental experts. A third worked on conceptual design of a variety of products and had limited environmental expertise. Of the three, the first group benefitted most from the tool concept due to the relatively narrow range of products and greater need for independent analysis.

From a usability perspective, ease of use was critical, and the structure of teams and access to expertise were deciding factors in the tool’s value to each team. The tests determined that an LCA-based tool would best serve a team that focuses on a narrower set of products with a rapid development cycle and limited access to environmental experts.

Conclusions
Since decisions made during product development drive the impacts of final products, there is a strong business case for integrating environmental assessment into this process. Enabling product developers to optimize environmental performance among another attributes is critical to optimizing environmental and business results.

This effort to develop an early-stage LCA tool illustrates the feasibility of integrating LCA into product development and some of the considerations that determine success, including team structure, data accuracy, and interaction between multiple corporate functions. An ideal tool will pair comprehensive environmental assessment with the iterative requirements of product development.

The field of user-friendly software for product developers is still emerging and is heading toward increased accessibility of LCA processes to nonexpert users. For example, the author is aware of new efforts to develop software packages that emphasize resolution of the usability challenges facing expert-focused LCA software.

The most significant gap is the need for further data development. In the short term, companies will need to make strategic decisions about investing in high-quality data development and management. In the long term, the business case for product-based environmental assessment will partially drive improvements, but supporting regulations are needed to ensure accurate and consistent data. This represents an opportunity to work with software developers, corporate supply chains, industry associations, and government to improve data standards and quality.

Beyond appropriate tools and data improvement, each company will need to answer specific questions when integrating LCA into product development. Which environmental impacts are most important to the company and what performance benchmarks should product developers strive to meet? What degrees of complexity do product developers face, and what tools are most appropriate for each development stage? How should environmental data be integrated with existing systems? What resources are required to supplement and complement the data-driven approach? In answering these questions, environmental managers will be well positioned to provide their companies’ product development teams with more accurate, usable and business-focused assessment tools.

References
2. EU Ecolabel. See http://ec.europa.eu/environment/ecolabel/.
The Wood Buffalo Environmental Association (WBEA) is a community-driven, environmental, non-profit organization dedicated to the operation of world class, state-of-the-art monitoring programs. The WBEA monitors and communicates information on ambient air quality and air-related environmental impacts in the Wood Buffalo Region.

The WBEA is soliciting Letters of Interest including statements of qualifications and professional experience from interested parties that would like to receive a Request for Proposal (RFP) for the Operations and Maintenance and/or Quality Assurance / Quality Control (QA/QC), Data Management and Reporting for the WBEA regional air monitoring network.

The ambient air quality monitoring network consists of 15 air monitoring stations within the Regional Municipality of Wood Buffalo that continuously monitor air quality and/or meteorological parameters including: sulphur dioxide, oxides of nitrogen, hydrocarbons, total reduced sulphur compounds, ozone, carbon monoxide, hydrogen sulfide, ammonia, particulates, wind speed and direction, etc. Certain stations also intermittently monitor Volatile Organic Compounds (VOC), Annular Denuder, Precipitation, Poly Aromatic Hydrocarbons (PAH), particulates (PM2.5 & PM10), and passives samplers. Please note not all stations monitor all parameters, please visit our website for more details.

NOTE: Submission of a Letter of Interest does not obligate an institution or individual to submit a proposal for the Wood Buffalo Environmental Association, and is not required in order to respond to a future request for proposals. Nor does submission of a Letter of Interest guarantee an opportunity to submit a proposal. However, companies interested in being considered for this work are strongly encouraged to apply. A Request for Proposals for WBEA is anticipated to be issued in January 2010.
Whole building assessment systems like BRE Environmental Assessment Method (BREEAM; used in the UK), Green Globes (Canada and USA), and Leadership in Energy and Environmental Design (LEED; USA) rightly place considerable emphasis on the selection of green materials or products as an important aspect of sustainability. Building design teams are clearly concerned about this topic, but are increasingly aware of the time and resources needed for, and the uncertainties associated with, the search for reliable information.

Designing, constructing, and operating environmentally friendly buildings is complex and there are few, if any, simple answers, especially when it comes to materials selection. The reality is that we are constantly forced into a balancing act, trading off a good effect here with a not-so-desirable outcome there. Life cycle assessment (LCA) has taken center stage in the past few years as a critical methodology for dealing with these complex issues, getting the focus off simple product or material attributes and onto true environmental performance measures.

As an example, some rating systems give credit for materials produced within a given distance of the structure being built. This makes sense on an intuitive level, since less energy will be required to transport the materials. But there are a tremendous number
of factors that influence whether or not a material produced locally is better for the environment, including the source of its components, type of manufacturing process, and mode of transportation. So, in fact, using locally produced materials could either add to or detract from a building’s sustainability.

Following an overview of LCA with an emphasis on its application to buildings, this article highlights tools that can be applied at different stages in the project delivery process, and then outlines the approaches for integrating LCA in Green Globes and LEED. Although the use of LCA in rating systems and standards is happening in various parts of the world, the focus here is on North America.

**Life Cycle Assessment: An Overview**

Put simply, LCA is a methodology for assessing the environmental performance of a product over its full life cycle. Environmental performance is measured in terms of a wide range of potential effects, such as fossil fuel depletion, global warming potential, stratospheric ozone depletion, and acidification. All of these measures are indicators of the environmental loadings that can result from the manufacture, use, and disposal of a product. These “mid-point” indicators are linked to, but do not directly address, the ultimate human or ecosystem health effects, a much more difficult and uncertain task. However, they do provide good measures of environmental performance, since reducing any of these effects benefits the environment.

In LCA, the effects associated with making, transporting, using, and disposing of products are referred to as “embodied effects,” where the word embodied is not meant to imply true physical embodiment, but rather attribution or allocation in an accounting sense. In the building community, the tendency is to refer primarily to “embodied energy,” but there is a wide range of embodied effects, as noted above. The energy required to operate a building over its life overshadows the energy attributed to the materials used in its construction and maintenance. However, other embodied effects generated during the resource extraction and manufacturing stages greatly outweigh any such releases associated with building operations.

For example, solid wastes are generated during the resource extraction, manufacturing and on-site construction stages of the life cycle; significant air emissions are generated during all of the intermediate transportation steps; and toxic releases to water and air are almost entirely a function of product manufacturing as opposed to building operations. Moreover, energy itself requires energy for its production and transportation, which can result in a full range of emissions (known as “precombustion effects”).

To the extent possible, we should consider and balance all of these effects throughout the full life cycle of a product or building. And we should bear in mind that material choices directly influence the operating effects for a building (e.g., the thermal properties of envelope materials). When we take a full life cycle approach, we may find that accepting a penalty in one stage of the life cycle, or with regard to specific measures such as initial embodied effects, may yield overriding benefits.

It is also important to note that the LCA of a product should take account of the production and use of other products required for cleaning or maintaining the product during its use phase. For example, we should take account of the paints required to maintain some types of wood cladding, and of the cleaning products required to maintain various kinds of flooring. We must similarly take account of the repair and replacement of individual products through the building life cycle.

In LCA, we use the term “functional equivalence” when referring to the problem of ensuring that two or more products provide the same level of service and that comparisons are fair from that perspective. Ensuring functional equivalence is not as easily accomplished in building applications as might be supposed because the choice of one product may lead to, or even require, the choice of other products. For that reason, comparisons may have to be made in a building systems context rather than on a simple product-to-product basis. In general, product-to-product comparisons are more likely to be misleading when dealing with structure and envelope materials, where the systems context is key. In a similar vein, we should be careful to take account of all the components that may be required during building construction to make use of a product. Mortar and rebar go hand in hand with concrete blocks, just as fasteners, tape,
and drywall compound are integral to the use of gypsum wallboard.

The final point to note about LCA is that it is not the same as life cycle costing (LCC). The two methodologies are complementary, but LCC focuses on the dollar costs of building and maintaining a structure over its life cycle, while LCA focuses on environmental performance measured in the units appropriate to each emission type or effect category. For example, global warming gases are characterized in terms of their heat trapping effects compared to the effects of carbon dioxide (CO₂), and so global warming potential is then measured in equivalent amounts of CO₂.

The LCA Toolkit

Some years ago, the Athena Institute developed a simple LCA tool classification system, which contemplates the following three main levels of tools:

- **Level 1 – Product Focus**
  1A – For LCA practitioners
  SimaPro, GaBi, Umberto
  1B – LCA in the background
  BEES (NIST)
- **Level 2 – Assembly Focus**
  Athena EcoCalculator
- **Level 3 – Whole Building**
  Athena Impact Estimator

The Level 1A tools are designed for use by LCA practitioners, offering flexibility in terms of the data that are used and various steps in the LCA process, but requiring considerable expertise in the subject. In contrast, the Level 1B, 2, and 3 tools have the LCA in the background to make LCA more accessible to the building community; design teams can input design options at the product, assembly, or building level and get back instant LCA results to help make final choices. In North America, only the listed tools are currently available at these levels, although new tools will probably emerge. The Level 2, assembly focused tool is especially relevant here because it is the starting point for the integration of LCA in the rating systems.

The Green Building Initiative (GBI) originally commissioned development of the Level 2 Athena EcoCalculator for Assemblies by the Athena Institute, in association with the University of Minnesota and Morrison Hershfield Consulting Engineers, for use with the Green Globes environmental assessment and rating system for commercial buildings. Recognizing its potential for more widespread application, GBI subsequently donated its share of the intellectual property so that a generic version could be made freely available on the Institute’s Web site at www.athenasmi.org.

The EcoCalculator provides instant LCA results for hundreds of common building assemblies, including exterior walls, roofs, intermediate floors, interior walls, windows, and columns and beams. The information embedded in the tool is based on detailed assessments completed with its parent software, the Athena Impact Estimator for Buildings.

Integrating LCA in Building Rating Systems

There are several ways that LCA could be introduced in rating systems, ranging in level of effort from fairly easy to relatively onerous. For example,

1. Educational credits — if you use LCA, you get
points irrespective of the results or use of the results in the design process;
2. Credits that encourage manufacturers to implement LCA by giving points for the use of products that are accompanied by proof of an LCA or that have an LCA-based ISO Type III label (an Environmental Product Declaration);
3. Credits for selecting pre-studied building assemblies that are highly ranked in terms of LCA results; and
4. Credits for exceeding LCA benchmark levels at the whole building level.

The first two methods have appeal for obvious reasons, but they are not likely to advance the cause of environmental performance to a very great extent. One problem is that LCAs can vary in quality for a variety of reasons, and simply completing even a high-quality LCA has little value if the results are not brought to bear on decisions.

The third method has the merit that the LCA work can be done in the background, without requiring the use of specialized tools by design teams, but there is the problem of maintaining a sufficiently rich menu of design options from which teams can choose.

The fourth method puts the focus strictly on environmental performance measures, leaving it entirely up to the design team to decide how to achieve the required results. Moreover, this approach would allow embodied effects to be combined with operational effects so that realistic trade-offs between material use and operating performance would be handled automatically. Indeed, LCA performance criteria could entirely replace many of the credits in the operating energy section of a rating system. However, this method also puts an onus on rating system developers to study enough buildings to establish performance benchmarks at the whole building level.

In the case of the Green Globes rating system, a recommendation was made to use the assembly ranking approach (method 3 above) and GBI subsequently funded development of a credit calculator based on the now freely available EcoCalculator, as noted previously.

In the case of U.S. Green Building Council, a stakeholder meeting in September 2004 resulted in the creation of working groups, one of which was charged with establishing the goal and scope for integration of LCA in the different LEED rating system products. After considerable deliberation, that group also recommended the assembly ranking approach as a less-than-ideal but best near-term approach. Following ratification of that recommendation, efforts focused on how best to accomplish the task in terms of tools and credit language, leading eventually to a decision to use the EcoCalculator as the basis for inputs to a separate LCA credit calculator.

Both rating system organizations have a long-term objective of switching to the more ideal approach of whole building LCA (method 4 above), but benchmarks will first have to be put in place. In addition, both want to make sure there is an option for the use of tools other than just the EcoCalculator for assembly assessment; the trick is to ensure reasonable equivalence and maintain a level playing field. That, in turn, requires setting criteria with regard to data, life cycle stages that must be included, and other factors—not a trivial exercise.

**Conclusions**

The selection of environmentally sound or friendly (so-called “green”) building materials is complex and there are no easy solutions. One has only to walk the floor at any major building materials exhibition to see the problem; few, if any, vendors fail to make the claim that their product is “green” on the booth banner and in their literature.

The reality is that most building products have both positive and negative aspects when it comes to environmental performance. The task is to balance the pros and cons, understand the trade-offs in terms of true environmental performance measures, and use materials to their best advantage, recognizing that all buildings typically incorporate a wide range of materials. LCA is no panacea, but it is the best method we have right now to shift away from simple labels and a focus on single attributes to true environmental performance measures. The integration of LCA in Green Globes and LEED is most certainly a step in the right direction, leading on a path that should and must be improved and made progressively easier to tread. em
Upcoming Air & Waste Management Association Webinars

Coal Combustion Residues and Beneficial Uses
December 10, 2009 • 2:00-4:00 p.m. Eastern

“Coal Combustion Residues and Beneficial Uses” will discuss new developments in the storage and disposal of coal ash and the advantages of using coal combustion products (CCPs).

This timely Webinar will bring together industry experts and will cover related topics including:

• Current regulations on the disposal of coal ash
• Flue gas desulfurization (FGD) by-products and where they come from
• Safe methods of handling FGD by-products
• Trace elements found in coal ash and FGD by-products
• Different uses of CCPs
• Advantages of using CCPs in various applications

Renewable Biomass Energy: Reducing Carbon Footprint and Saving on Fuel Costs
January 14, 2010 • 2:00 – 4:00 p.m. Eastern

Join presenter Thomas M. McGowan, president and founder of TMTS Associates, for “Renewable Biomass Energy: Reducing Carbon Footprint and Saving on Fuel Costs” to get the information you need to choose and implement an environmentally-friendly energy system designed to meet your organization’s needs.

This informative Webinar will discuss all aspects of biomass and alternate fuels, including information about:

• Converting these fuels into energy
• Required equipment and installation processes
• Alternative fuels’ effect on capital, operating, and production costs
• How using alternative fuels can reduce air pollution emissions (including basics of greenhouse gas calculations methods)
• Direct combustion of wood and biomass
• Production of liquid fuels from biomass
• Cost comparison for competing alternate fuels, including gas, solid wastes, and oil

WEF/A&WMA Odors and Air Pollutants 2010
March 21-24, 2010 • Charlotte, NC

As communities grow in size and population, more municipal, industrial, and agricultural facilities are confronted with issues related to odors and air emissions. To assist the air and water quality professionals tasked with the effective management of these pollutants, the Water Environment Federation (WEF) and the Air & Waste Management Association (A&WMA) are cosponsoring the international specialty conference Odors and Air Pollutants 2010, in cooperation with the North Carolina Water Environment Association.

Odors and Air Pollutants 2010 is designed to foster informed decision-making and encourage the use of effective innovative technologies. The conference’s technical program stresses real-life experiences and lessons learned. The conference will include oral presentations, interactive discussions, posters, workshops, and exhibits.

The International Conference on Thermal Treatment Technologies and Hazardous Waste
May 17-20, 2010 • San Francisco, CA

Thermal technologies play a key role in energy recovery, resource conservation, and waste treatment around the world. The International Conference on Thermal Treatment Technologies & Hazardous Waste Combustors invites thermal treatment professionals and academicians working in all aspects of the industry to join globally-recognized experts from research and development, and pilot and full scale thermal technologies in operation, public policy, and regulation to solve difficult waste management, resource conservation, and energy recovery challenges.

The conference will feature state-of-the-art technical papers on a broad range of topics, opportunities for discussions with equipment providers and technical service firms, and technical tours of area waste management and recycling facilities. There will be ample networking opportunities with potential customers from industry and academia, and social events where participants can mingle and enjoy the San Francisco area.
Achieving Consensus on the Assessment of Toxicity in LCA

by Michael Hauschild, Mark Huijbregts, Olivier Jolliet, Manuele Margni, Dik van de Meent, Ralph Rosenbaum, and Thomas McKone

Michael Z. Hauschild, Technical University of Denmark (DTU), Lyngby, Denmark; Mark Huijbregts, Radboud University, Nijmegen, The Netherlands; Olivier Jolliet, University of Michigan, Ann Arbor, MI; Manuele Margni and Ralph K. Rosenbaum, Ecole Polytechnique de Montreal, Canada; Dik van de Meent, Radboud University, Nijmegen, and the National Institute of Public Health and the Environment (RIVM), Bilthoven, The Netherlands; and Thomas E. McKone, University of California, Berkeley. E-mail: mic@man.dtu.dk.

Life cycle assessment (LCA) is a central tool in the assessment of the environmental sustainability of products and systems, and the assessment of chemical emissions from the life cycle is particularly important in order to ensure broad coverage of the environmental impacts that an LCA must encompass, including compound toxicity.

Different models have been developed to characterize the toxic impacts in LCA, but they vary substantially in their scope, applied modeling principles, and not least, in terms of the characterization factors (CFs) they produce. In addition, their substance coverage is modest, typically with CFs published for less than 1000 substances.

This leaves the LCA practitioner who wishes to include the chemical-related impacts in the impact assessment in a situation where: (a) there will often be many substances in the life cycle inventory for which no characterization factor is available from any of the models; and (b) for some substances there may be factors from several of the models, but they often vary substantially among the models. Faced with this situation, many practitioners choose to exclude the chemical-related impacts from the Life Cycle Impact Assessment (LCIA) phase of the assessment, and this de facto reduces it to an energy impact assessment.

This unsatisfactory situation was the background on which the joint United Nations Environment Programme (UNEP) and Society of Environmental Toxicology and Chemistry (SETAC) Life Cycle
Initiative (see sidebar at right) established a Task Force on Toxic Impacts with the following objectives:

- Identify good modeling practice for characterization modeling of ecotoxicity and human toxicity;
- Harmonize existing models;
- Recommend characterization model and CFs for many substances; and
- Offer guidance on the use of CFs.

This article describes the consensus process and its results in the form of a scientific consensus model. It draws on the papers cited in references 1 and 2, where more detailed discussions of the central elements of the consensus model and the assessment of toxicity in LCA may be found. For a discussion of the characteristics of the LCIA phase, reference 3 may be consulted, while reference 4 gives an updated description of all the methodological elements of environmental LCA.

**Assessment of Sustainability**

The sustainability of a company’s activities depends on their consequences in terms of environmental, social, and economic impacts. A company can influence the actions of the different actors along its product chains; from its suppliers and their suppliers upstream in the chain, to customers and users, to the disposal or recycling of the products downstream in the chain (see Figure 1). A life cycle perspective is therefore needed when the sustainability of a company’s chemical, product, or process is assessed. For examination of the environmental dimension of sustainability, LCA is the relevant analytical tool.

LCA has been standardized by the International Standards Organization (ISO): ISO 14040 and ISO 14044. In environmental LCA, the focus is on the exchange of resources and emissions that occur between the surrounding environment and the processes in the product life cycle from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (i.e., from cradle to grave). The quantified exchanges are translated (characterized) into their potential
impacts on the environment, and all relevant environmental impacts should be included in the assessment, ranging from local land use impacts to regional impacts (e.g., emissions of acidifying substances or toxicants) to global impacts (e.g., climate change). This translation is performed in the LCIA phase of the LCA methodology.

**Life Cycle Impact Assessment**

For each category of impact (e.g., global warming or toxicity to ecosystems), the impact assessment applies substance-specific CFs, which represent the substance’s potency (i.e., its specific ability to contribute to the impact category). The characterization occurs simply by multiplying the emitted quantity of the substance by the CF.

LCA is often used for comparisons of products or systems, and for a given impact category it is therefore essential that the CFs give a correct relative representation of the potency of the individual substances (e.g., an emission of 1 gram of substance A contributes 15 times more than and emission of 1 gram of substance B). Likewise, it is important that the different impact categories are treated in a similar way and that the use of conservative estimations for some of the categories is avoided, since this would introduce a bias in comparisons across impact categories.

ISO 14044\(^6\) recommends that CFs and the models to derive them (characterization models) are internationally accepted (i.e., based on an international agreement or approved by a competent international body). For example, in the case of greenhouse gases, the global warming potentials (GWPs) developed by the Intergovernmental Panel on Climate Change (IPCC) are normally used as CFs for the climate change impact category.

For the impacts of chemical emissions on human health or ecosystem functions, there exist no similar factors approved by a competent international body that cover all the relevant substances. The chemicals in industrial use are numbered in the tens of thousands, and any of them can, in principle, occur in the emissions inventory for a product. Many of these substances have the potential to damage humans or ecosystems when released to the environment and, therefore, should have CFs for the human and ecotoxicity categories of impact.

**Impacts of Chemicals**

Over the years, several dedicated life cycle impact assessment models have been developed for the characterization of human and ecotoxic impacts. They follow the approach normally taken in chemical risk assessment, with a separate analysis of the fate of the chemical in the environment, the exposure of humans that may result, and the effects that exposure may have on human health or on the health of ecosystems.

The fate analysis considers transport of the chemical from the emission compartment to other environmental compartments and transformation of the chemical by biodegradation, chemical, and physical transformation. The results of the fate analysis can be expressed in a fate factor (FF), often in the form of an environmental residence time.

The exposure analysis considers the numerous possible routes through which human beings or ecosystems can be exposed to chemicals in the environment (e.g., via direct inhalation/ingestion or indirectly via food). For ecosystems, an exposure analysis conveys the bio availability of the chemical in the environment. The exposure analysis results in an exposure factor (XF), expressing the efficiency of the transfer of the substance from the environment into the human or the living organisms of the ecosystem.
The effect analysis collects information from laboratory results about the ability of the substance to cause harmful effects on humans or animal species and plants. The results of the inherent toxicity are expressed as concentrations of the substance in environmental media eliciting a given level of effect (e.g., reduced fertility or mortality). The results of the effect analysis can be expressed as an effect factor (EF), often in the form of an effect caused by a certain environmental concentration or a certain dose in the case of human exposure.

The CF for human or ecotoxic effects of a substance \( (i) \) can therefore be calculated as the product of three factors:

\[
CF_i = FFi \times XFi \times EF_i
\]

**Survey and Selection of Existing Models**

The work of the UNEP–SETAC Task Force on Toxic Impacts began with a survey and pre-selection of existing characterization models. Next, the task force developed criteria for model structure and detail, and procedures for comparing the pre-selected characterization models. Based on a comparison of existing models, the task force identified recommendable model elements and developed a consensus model intended to be the basis of future recommendations of characterization factors (see Table 1).1,2

In a continuous process of running the existing models on the same group of substances, analyzing underlying causes of differences in the outcome, and revising and harmonizing the models to eliminate unintentional differences, the models exhibited significantly reduced variations in CFs. This progress is illustrated in Figure 2.

**Development of a Scientific Consensus Model**

The final version of the consensus model fits satisfactorily with the existing models, even after these were revised and their internal variation strongly reduced (see Figure 2). The task force named its scientific consensus model the UNEP–SETAC Toxicity Model (USEtox™) and it is currently under consideration for recommendation by the board of the UNEP–SETAC Life Cycle Initiative.
The USEtox™ model has been applied to a large substance database with the required input parameter values for thousands of substances and produced recommended or interim CFs for human toxicity and ecotoxicity.²

Work around the USEtox™ model continues, and among the planned activities are:

- Quality assurance of the substance data used to calculate the characterisation factors and linkage of the USEtox™ substance database to other existing substance property databases.
- User-friendly programming of the consensus model, which currently only exists as a research model programmed in Microsoft Excel.
- Uncertainty estimates on the USEtox™ CFs.
- Development of USEtox™ to accommodate metals.
- Development of USEtox™ to accommodate indoor emissions.
- Full documentation of USEtox™.
- Inclusion of terrestrial ecotoxicity as an endpoint in USEtox™.
- Industry workshops on comparative assessment of chemicals and training courses in USEtox™.

One of the advantages of basing CF recommendations on a consensus model, rather than on individual research models, is that since LCA practitioners require stable factors, they don’t run the risk of getting different results—and perhaps conclusions—if they repeat a study, merely because the characterization model has been modified. The research models will continue their development, but the recommended factors can remain constant until an update is decided by UNEP–SETAC. When this happens, it is foreseen that the USEtox™ model will be updated after a similar model comparison involving the other characterization models that are in use at the time.

**Interpreting USEtox™ Results**

The USEtox™ model is of particular relevance to the management of chemicals, as it provides a harmonized approach to assessing and evaluating risks from chemicals embedded within products. LCA practitioners can use the model’s CFs to identify the substances with the greatest toxicity for a particular product, but large inherent uncertainty of the factors represents a challenge to the interpretation. Even after the revision and harmonization of the existing characterization models, the variation between them is up to three orders of magnitude for a given substance (which should be seen on a variation of up to 12 orders of magnitude between substances)
We can not say which of the models is correct, but since USEtox™ is derived from the existing models, the inter-model variation may be taken as an expression of the inherent uncertainty of the CFs it provides. While it may be difficult to use USEtox™ to determine the exact impact of a compound on toxicity, the model is effective at identifying 10–20 priority chemical emissions in the life cycle inventory, and perhaps more importantly, disregard the hundreds of other substances whose life cycle impacts are insignificant. More information about the USEtox™ model can be found at www.usetox.org.

Table 1. Criteria for comparison of fate, exposure, and effect elements of characterization models.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>An Ideal Model:</th>
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<tr>
<td>Comprehensiveness</td>
<td>Covers most important environmental impacts on human health and ecosystems.</td>
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<tr>
<td>Environmental Relevance</td>
<td>Reflects latest state of knowledge and is appropriate for its domain of validity.</td>
</tr>
<tr>
<td>– Fate</td>
<td>Does not consider advection out of a region or a continent a final loss.</td>
</tr>
<tr>
<td>– Human exposure and effect</td>
<td>Makes use of dose-response relationships (e.g., linear slope at the benchmark dose or extrapolation from NOAEL to LOAEL, preferably using human data) and avoids the use of reference doses and safety factors.</td>
</tr>
<tr>
<td>– Ecotoxic effect</td>
<td>Makes use of effect indicators at the HC50 level (geometric mean of Effect Concentration EC50) for ecological impacts, based on the most representative, not the most sensitive species.</td>
</tr>
<tr>
<td>Scientific Validity and Reliability</td>
<td>Uses chronic data, but acute data is acceptable as a basis for extrapolating to chronic values.</td>
</tr>
<tr>
<td>Applicability</td>
<td></td>
</tr>
<tr>
<td>– Spatial</td>
<td>Has well-defined geographical applicability.</td>
</tr>
<tr>
<td>– Sparse data</td>
<td>Has continental average characterization factors.</td>
</tr>
<tr>
<td>Compatibility with Weighting</td>
<td>Delivers output which can be translated into damages to human health and natural ecosystems</td>
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References

On the Path to Sustainability: A Pollution Prevention Success Story
by Chris Moore

“Sustainable operations.”

“Reduce environmental impacts.”

“Achieve environmental excellence.”

Corporations frequently use these types of phrases in environmental values and vision statements. Often, however, such phrases can become stagnant on the company bulletin board, as the execution falls short of the vision. Like many corporations, Alcoa Inc.’s environment, health, and safety (EH&S) policy includes a specific principle: “We support pollution prevention and sustainable development by incorporating social responsibility, economic success, and environmental excellence into our decision-making process.” A recently completed project represents Alcoa’s success story of using pollution prevention to improve sustainability of a production operation and avoid the costs of add-on pollution control.

Background
Alcoa produces primary aluminum, fabricated aluminum, and alumina for many industrial sectors, including aerospace, automotive, packaging, building and construction, and commercial transportation and industrial markets. Alcoa’s Tennessee Operations is a producer of aluminum can sheet for the food and beverage market. Operations at the facility include aluminum ingot production, rolling mills, and can sheet production. In addition, the facility operates a used beverage container (UBC) recycling operation that supplies approximately 50% of the aluminum input to the can sheet production process. The recycling process involves the shredding of UBCs, followed by delacquering and remelting into molten aluminum. Recycling is a critical process, given that the energy input needed to produce molten aluminum from recycled metal is only 5% of the energy input needed to produce aluminum from smelting operations.

The Opportunity
Within the recycling operation, the delacquering process uses greater than 900 °F air to remove inks and coatings from the UBCs prior to their remelting and reuse in the can sheet manufacturing process. Various pollutant emissions are formed during this process, including hydrogen chloride (HCl). Historically, the main driver for HCl emissions has been the polyvinyl chloride (PVC) used in beverage can coatings.

In 2001–2002, in order to meet the Maximum Achievable Control Technology (MACT) requirements of the National Emission Standard for Hazardous Air Pollutants for Secondary Aluminum Production, Alcoa evaluated the installation of lime-injected fabric filter control systems for the delacquering furnaces. Emissions tests had revealed that the delacquering furnaces exceeded the MACT standard for HCl. At the same time, an initiative to reduce PVC from beverage can sheet coatings was gaining momentum within Alcoa and the entire aluminum can sheet industry. In fact, Alcoa had begun research and development efforts to explore the elimination of PVC in beverage cans as early as 1990.

Considering the options at hand, Alcoa made the decision to expedite the PVC-free initiative as a pollution prevention project that would potentially result in compliance with the Secondary MACT standard for the delacquering furnaces. A team of individuals within the company, including representatives from production, quality assurance, customer service, coatings, and environment, health, and safety, was formed to work together to navigate this effort. Two major paths of execution were needed to accomplish the project: (1) converting to PVC-free coatings with successful customer qualification and (2) gaining regulatory approval for the pollution prevention approach.

Converting to PVC-Free Coatings
To accomplish this conversion, alternative coatings that met production needs were identified, coating processes were permanently changed to enable use of the new coatings, the PVC-free coated metal was qualified at customer locations, and full production was initiated. Following coating conversion and after introduction in the consumer market, the PVC-free UBCs eventually made their way into the recycled beverage can stream. As levels of PVC in the overall beverage can stream were reduced, so too were emissions of HCl.

Gaining Regulatory Approval
The biggest obstacle to the pollution prevention initiative was timing. It was uncertain that enough conversion to PVC-free coatings would occur in the recycled beverage can stream to result in lower HCl emission levels from
Mission Accomplished
Rather than take the costly—and more straightforward—path of installing air pollution control systems to solve a complicated air emissions problem, a sustainable pollution prevention approach was employed. Taking the less certain path of changing an industry standard within an expedited timeframe to meet a major environmental standard resulted in significant emission reductions without significant cost. With lower emissions, lower costs, and a more sustainable operation, both environmental and economic successes were achieved!

Chris Moore is an environmental engineer with Alcoa Inc. E-mail: chris.moore@alcoa.com.

Where Are Your Opportunities?
As you consider opportunities to implement sustainable pollution prevention projects at your company, several important lessons can be learned from this project:

• Sustainable pollution prevention projects require advance planning and coordination. The earlier an opportunity is identified, the greater the likelihood of success.
• A culture must be cultivated across an organization where creative and innovative environmental solutions are considered alongside traditional solutions.
• Identifying pollution prevention opportunities requires good organizational communication among research and development, process, technical, and environmental teams.
• Early and frequent coordination with state and federal regulatory agencies is critical to success. State and federal agencies can provide input on similar project experiences that may provide valuable insight to potential opportunities.
• Accurate data and data management systems are a must! From stack test results and emission calculations to market trend data and economic analyses, the ability to use existing data to predict future outcomes of potential projects will be instrumental in building an internal business case and quantifying benefits externally to customers and regulatory agencies.

A&WMA’s Masters and Doctoral Thesis Awards
Nomination Deadline: January 15, 2010

Do you have a student who authored an exceptional thesis in 2009? If so, nominate the thesis for an A&WMA Masters and Doctoral Thesis Award!

Nominations should be original work that makes a significant contribution to the fields of air quality, waste, or sustainability/management pertaining to air quality or waste, and must be made by faculty advisors who are members of A&WMA.

Visit www.awma.org/go/thesisawards to find out more about these awards or to download the nomination criteria.
Consultant Recognized for Being On Her Game

As we approach the end of 2009—a year many of us would rather soon forget—it’s hard not to be hopeful for a better 2010. It couldn’t get any worse, right? As in any recession, observers talk about how a vibrant market allows companies to get complacent and how, once the downturn has passed, only the strong will survive. In today’s market, environmental professionals cannot afford to be complacent.

They need to do everything in their power to position themselves with prospective clients and use every networking avenue available to build their reputations as technical experts. The inspiration for this month’s column came from an environmental consultant who did just that, and was recently recognized for her efforts from a leading commercial real estate association as a “woman to watch.”

I subscribe to dozens of commercial real estate news feeds, and a recent one from Commercial Property Executive proclaimed, “CREW Awards 20 Women Under 40.” CREW is the Commercial Real Estate Women Network. What I did not expect to find as I scanned the list of names was an environmental professional. Elizabeth Krol, a professional geologist and client program manager for Shaw Environmental Inc., was one of the 20 women selected from more than 120 nominees as someone CREW deems likely to be an “influential leader in the industry.” The other recipients were from the legal, investment, development, finance, brokerage, institutional, and construction sectors, from such esteemed firms as Grubb & Ellis, Wachovia Real Estate Securities, and NorthStar Advisors.

Our industry is constantly evolving into new technical areas, and Krol is a good example of someone who positions herself where the action is. Name a timely environmental topic—carbon risk, green building due diligence, Leadership in Energy and Environmental Design (LEED)—and there’s a good chance she is already on a technical committee that is driving the issue forward. I get the distinct impression that Krol does not wait long to return a client’s call, even on nights and weekends. She is also actively involved in programs to mentor and train young environmental professionals at Shaw. I recently had the opportunity to ask Krol a few questions about the award and her own personal networking efforts.

Crocker: How long have you been involved with CREW?
Krol: I’ve been a member of CREW, and the Boston Chapter, New England Women in Real Estate, since 2003. I had been invited to meetings by a friend at a prominent law firm prior to that time, but it wasn’t until I joined a committee and became actively involved that I really got to know other members and maximized the benefits of membership.

What benefits do you see from your involvement with groups like CREW? How important is this award?
It is a tremendous honor from a prestigious national organization of more than 8000 women strong, and to be nominated with such an impressive peer group has been incredibly gratifying. To be selected is truly the icing on the cake.

What advice do you have for young environmental professionals just breaking into the field?
Ask lots of questions. Honestly, your manager would rather that you asked than assumed or, worse, did not take action. Once you have the direction needed, take action! Always push a project forward whenever you can. Time is of the essence in a transaction, so ideally, the project needs to be moving forward, toward a successful resolution for

Elizabeth Krol, a professional geologist and client program manager for Shaw Environmental Inc., was one of 20 women selected as a ‘woman to watch.’
the client, as efficiently as possible. Also, always say thank you, especially to your clients, managers, and mentors. There is a dearth of good manners in the new economy due to stress and budget constraints. Be polite and it will be appreciated. Focus, teamwork, and good manners make all the difference.

What are your secrets to success?
Making my clients my highest professional priority, and meeting and exceeding their needs by focusing on quality and responsiveness. I also assemble the best team possible, focused on a single objective, and I empower them to take action and trust that they will make good decisions in the best interests of the client. Our team prides itself on solution-oriented thinking, which results in a cost-effective and efficient approach for our clients.

Closing Thoughts
Although impossible to forecast with any certainty, the economy will eventually recover. So, anything consultants can do now to position themselves with prospective clients will be rewarded. Krol’s CREW award is a great example of an environmental professional being honored not by an environmental association, but by an association in a key client sector: commercial real estate.

Access to new opportunities as the market recovers will come as the result of carefully nurturing your own professional network. There are countless avenues for doing this. Conferences are an obvious choice, but instead of attending environmental conferences where you and hundreds of other competitors will compete for time with a limited audience of potential clients, why not go to the conferences clients attend to stay abreast of technical issues? Virtually every client sector has its own share of industry trade shows, giving you ample opportunity to talk to your targeted client sectors on their territory. Join their organizations, rather than waiting for them to come to yours. This can be a valuable way of making critical connections that will distinguish you and your firm from the pack. Such efforts can go a long way toward helping you build a personal brand and, hopefully, land new clients more effectively than your competitors.

In the toughest economy we’ve seen in years, Krol is on her game. Are you?
Climate Change and GHG Legislation Invigorate the EH&S Software Market

by Jill Gilbert

Jill Barson Gilbert, QEP, is president of Lexicon Systems, LLC. E-mail: jbgilbert@lexicon-systems.com.

Are greenhouse gas (GHG) emissions an environmental management/sustainability issue or a business issue? It depends upon whom you ask—scientists and engineers or corporate executives. No matter the answer, anticipation of a new “carbon economy” has ignited the environment, health, and safety (EH&S) software market.

In September and October 2009, I interviewed executives at seven EH&S software companies in a range of market niches to get their perspectives on how GHG and sustainability issues have impacted the EH&S software market. This column provides a summary of my findings.

Sustainability Has Changed How Executives View EH&S Issues
Sustainability is an overarching theme that has received significant attention at the corporate executive level, with many companies opting to join the Dow Jones Sustainability Indexes (indexes that track the financial performance of the leading sustainability-driven companies worldwide). “Sustainability is the next level of business operational excellence,” says TechniData America’s Stephen Illes.

In the past, EH&S was focused purely on compliance; that is, scientists and engineers created solutions just for themselves. Sustainability, however, has a broader impact on the processes that run a business. Also, traditional EH&S issues are local issues, whereas climate change and GHG emissions are global issues. Broader, global impacts require a strategic approach and elevate EH&S to the executive level.

IHS’s Bert Turner noted that the buzz around GHG emissions developed in just two years. There was very little talk about GHGs at the 2007 CERAWeek global energy conference. In 2008, approximately 10–15% of the discussion was about GHGs, but by 2009, GHG topics comprised approximately 70% of the conference sessions. In a short time, the view of EH&S changed from cost burden to high-level risk management to business opportunity.

Spreadsheets Not Adequate for GHG Accounting
A carbon economy has a tremendous upside for many organizations, from both financial and company branding perspectives, making sustainability a strategic, forward-looking issue. Organizations must track, manage, verify, and achieve goals across the supply chain, and across geographies, in a very public fashion. GHG accounting calls for high-quality data, rolled up globally, near-real time, displayed in a way that a wide range of stakeholders can understand. It calls for standardized business processes, data transparency, and an audit trail.

The proliferation of spreadsheets, manual processes, and one-off software that many organizations use to track emissions does not work for large, multinational operations and lacks the transparency and audit trail that a carbon economy requires. Enviance’s Larry Goldenhersh says, “If you talk with people who are pretty sophisticated consumers of data, and use that data in the public market, they understand that their market capitalization will be affected by their ability to explain their carbon footprints.” They need software that stands up to stakeholder scrutiny.

GHG/Sustainability Software Market Segmented
The EH&S software market offers hundreds of GHG solutions, has several segments, but no clear leader. Some software vendors focus on certain industry “verticals,” while others appeal to a broader range of industries; some focus on certain environmental media, while others focus on business...
Discussion around boardrooms on environmental issues is no longer defined by words like “nice to do” and “early adopters.” Instead, one hears the terms “business critical,” “crossing the chasm,” and “creating competitive advantage”—all giving rise to a new lexicon that is being used at the executive level to identify and exploit opportunities where others see threats.

—John-David Phyper and Paul MacLean, Good to Green: Managing Business Risks and Opportunities in the Age of Environmental Awareness (John Wiley & Sons, 2009)

processes that transcend various media; and some provide focused “point” solutions, while others provide broader/deeper solutions.

The GHG software market encompasses four general types of businesses:

- **EH&S software vendors** who have environmental subject matter expertise and whose software and capabilities have matured along with contemporary environmental regulations, such as the U.S. Clean Air Act, U.S. Clean Water Act, Resource Conservation and Recovery Act, and Comprehensive Environmental Response, Compensation, and Liability Act.
- **Enterprise software vendors** like SAP with significant information technology (IT) expertise and have supply chain software installations at thousands of customer locations around the world.
- **Venture capital-backed startup companies** with business acumen and a “green” orientation.
- **“Big Four” accounting/consultancy firms** with considerable GHG auditing and accounting experience in Europe and who can apply their expertise in the United States once legislation passes.

Who currently owns the market? EH&S software firms with deep environmental subject matter expertise who have the “nuts and bolts” technical features, software companies with deep IT expertise who can consolidate and deliver data on the latest platforms, or the Big Four accounting/consultancy firms who have significant carbon accounting experience in Europe under their belts and can transfer their knowledge to the U.S. market? Simon Jacobson, director at AMR Research, asks, “Can EH&S vendors grow up into the carbon economy?

...Many vendors due to their backgrounds look at sustainability as a ‘birth right,’ but are immature in product approaches that can measure full carbon impacts on the supply chain.”

**IT Trends Include SaaS and the Web**

IT departments are short on resources, and some companies outsource many IT functions. As a result, Software as a Service (SaaS) is now accepted practice. “We have offered our solution as SaaS since 2000. 75% hosted our software in-house in the early 2000s; 75% use SaaS today,” according to Intelex’s Mark Jaine.

Several executives stressed the importance of GHG software delivered via the Web. “Solutions built on older technology will not make the grade,” says Hara’s Chris Farinacci. Solutions must be configurable and have a low total cost of ownership.

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Thanks to the following, who graciously agreed to interviews:

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<th>Name</th>
<th>Title/Position</th>
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<tr>
<td>Robert Johnson</td>
<td>President &amp; CEO</td>
<td><a href="http://www.ess-home.com">www.ess-home.com</a></td>
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<td>Rebecca Sternberg</td>
<td>VP of Sustainability</td>
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<td>Larry Goldenhersh</td>
<td>President &amp; CEO</td>
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<td>Chris Farinacci</td>
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<td>Bert Turner</td>
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<td>John Phyper</td>
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<td>Stephen Ross</td>
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<td>Neno Duplan</td>
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<td>Locus Technologies <a href="http://www.locustec.com">www.locustec.com</a></td>
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<tr>
<td>Stephen Illes</td>
<td>CEO</td>
<td>TechniData America LLC <a href="http://www.technidata.com">www.technidata.com</a></td>
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*In mid-September, shortly after the interviews with ESS executives were completed, IHS announced the purchase of ESS.*
They must be flexible and allow companies to innovate quickly. Web services and application programming interfaces (APIs) send data from one system to another. Web technologies, combined with electronic data interchange (EDI) standards, allow integration of several data sources that appears seamless to the software users. “The end-state platform for [GHGs] is the Internet,” says Goldenhersh.

Web 2.0’s collaboration and social networking tools, when added to data integration, will allow information exchange among regulators and the regulated community, companies, and their stakeholders, across the globe, in near-real time. Upcoming product innovations include richer technology platforms, seamless integration of disparate data sources, and the use of open-source applications. Ultimately, technology will allow delivery of an environmental platform for many issues, beyond GHG. “At the end of the day, this is all done under the umbrella of protecting the environment, but it will result in huge benefits—reduced energy consumption and reduced costs to do business,” says Locus Technologies’ Neno Duplan.

**Conclusions**
The Sarbanes-Oxley Act and pending GHG legislation in the United States has elevated EH&S to the executive level. Until recently, many organizations viewed EH&S issues as a cost of doing business. Most EH&S key performance indicators were backward-looking. Sustainability and GHG emissions management are forward-looking initiatives with a clear business upside. These initiatives require rigorous information management, audit trails, transparency, and executive accountability.

Silos of data, spreadsheets, paper-based tools and multiple business processes do not support data roll-up in large and global organizations. More sophisticated software will be the answer for many companies seeking GHG management solutions. While GHG reporting at first seems intimidating, several vendors have the combination of environmental, IT, and business expertise to make it manageable.
New North American Standard for LEDs

A new safety standard has been published for energy-efficient light bulbs. The harmonized standard was jointly developed by CSA Standards in Canada, Underwriters Laboratories Inc. in the United States, and Mexico’s National Association of Standardization and Certification for the Electrical Sector.

The associations developed the standard in response to consumer concerns over the end-of-life cycle of compact fluorescent lamps. The C22.2 No. 1993-09, Self-Ballasted Lamps and Lamp Adapters Standard sets minimum material specification for the plastic housing. It also adds several end-of-life product tests to simulate potential failure modes. However, the standard does not address the amount of allowable mercury acceptable in lighting products.

The standard applies to lamp types such as light emitting diode (LED) fluorescent, compact fluorescent, high-intensity discharge, and tungsten-halogen. CSA Standards said that many lighting manufacturers already have plans in place to meet the new requirements. More information is available on the CSA Standards’ Web site, www.csa.ca

Four Green Energy Task Forces to Advise New BC Climate Cabinet

The British Columbia (BC) government is setting up a new Cabinet Committee on Climate Action and Clean Energy. Four new advisory task forces—collectively called the Green Energy Advisory Task Force—will report directly to the committee.

The Green Energy Advisory Task Force on Carbon Pricing, Trading, and Export Market Development will make recommendations to better position the province for any future cap-and-trade system. The task force will also look at carbon-pricing policies and how to integrate them with any BC cap-and-trade system.

The Green Energy Advisory Task Force on Procurement and Regulatory Reform will focus on improving BC Hydro’s procurement and regulatory regimes. It will also make recommendations regarding future clean power projects.

The Green Energy Advisory Task Force on Resource Development will advise the committee on sustainable development of natural resources used in renewable energy projects.

The Green Energy Advisory Task Force on Community Engagement and First Nations Partnerships will address how green projects can maximize benefits for communities.

The task force groups will also perform a comparative review of existing policies in other jurisdictions. Energy consultants, climate experts, clean-energy experts, academics, and environmentalists will form the task force groups.

Manitoba Mandate Requires 2% Biodiesel Blend

Manitoba has become the first Canadian jurisdiction to implement a biodiesel mandate. The province’s Biofuels Act, which came into effect November 1, 2009, establishes the legislative framework for implementing the biodiesel sales mandate, licensing biodiesel manufacturers, and adopting biodiesel fuel quality standards.

Fuel suppliers must blend 2% biodiesel in their overall sales of diesel fuel, both on-road and off-road. To meet the annual average of 2%, suppliers could blend 5% in the summer months and less in the winter. Additionally, the Manitoba government will replace the current fuel tax exemption with a five-year production grant of 14 cents per liter for all Manitoba-produced biodiesel.

The mandate will reduce 56,000 tons of greenhouse gas emissions each year, with biodiesel becoming widely available by summer 2010, the province said. The mandate builds on provincial legislation that came into effect on December 15, 2008. The Biodiesel (General) Regulation (Man. Reg. 178/2008) requires the licensing of biodiesel manufacturers and the adoption of fuel quality standards.

Canadian Report is compiled with excerpts from EcoLog News and the EcoCompliance.ca newsletter, both published by EcoLog Information Resources Group, a division of BIG Information Product LP. For more Canadian environmental information, visit www.ecolog.com.
The National Environmental Policy Act (NEPA) of 1970 established a broad environmental policy for the United States. The NEPA language was remarkably insightful in setting a national sustainability goal by calling for “the creation of conditions under which [humans] and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans [emphasis added].”

While NEPA set a vision, the task of fleshing out the implementation was assigned to the president’s Advisory Council on Executive Organization, chaired by Roy L. Ash. The Ash Council was also insightful. Recognizing that the “national government is neither structured nor oriented to sustain a well-articulated attack on the practices, which debase the air we breathe, the water we drink, and the land that grows our food,” it recommended that anti-pollution programs from five federal departments be combined to form a new agency that would “recognize the interrelated nature of pollution problems” and be the principal instrument for meeting this challenge.

Identifying the integrated nature of pollution problems is now more daunting than ever. The resilience of society and the environment is being tested by pressures of population and economic growth, which cause increasing greenhouse gas emissions, declining biodiversity, and other threats to water, soil, forests, and wetlands. Similarly, the rate of economic and environmental change is accelerating, as new products and materials are emerging faster than scientists can examine and respond to their impacts.

Multidisciplinary Approach
The interrelated environmental challenges of the 21st century cannot be neatly divided and addressed independently. The time is clearly at hand for a new systems-oriented and multidisciplinary approach. The National Research Council of the National Academy of Science has reached a similar conclusion, declaring that the nation’s environmental problems “can only be addressed through an understanding of the complex interrelationships among environmental media (air, water, land, and biota), human health, ecology, and economic sectors.”

From a regulatory or scientific perspective, integration across media programs has not been easy to achieve. EPA leaders and programs have recognized the need to move away from “stovepipe” visions and programs for individual media and toward solutions dealing with the environment as an integrated system. For example,

- In 1985, at the agency’s 15th anniversary, former administrator Russell Train (1973–1977) expressed his concern regarding EPA’s “compartmentalized nature” and its resulting ineffectiveness in dealing with pollutants, which “tend to move readily among air, water, and land.”

- Also in 1985, the then-current administrator, Lee Thomas (1985–1989), stressed the need for cross-media reviews, so that “we don’t just transfer pollutants from one medium to another.”

- In the early 1990s, then-administrator William Reilly encouraged cross-media approaches by looking holistically at place-based issues,
breaking down media barriers for risk assessment, providing cross-media training for staff, and conducting joint pilot studies with industry.

• In 1993, then-administrator Carol Browner launched the Common Sense Initiative—an experiment that addressed environmental management by industrial sectors rather than by environmental media. A few years later, Browner suggested developing a permitting approach for specific industries that would have consolidated U.S. Clean Air Act and U.S. Clean Water Act permit requirements.

Sustainability Science
In 2007, EPA’s Office of Research and Development created a new sustainability program and research strategy promoting a systems-based approach to meet society’s needs today and ensure a more sustainable future. The goal is to move the agency beyond one-dimensional, media-specific programs. To achieve this goal, the program focuses on sustainability science—a field of study with origins in both social and natural sciences that draws upon many existing disciplines to forge a multidisciplinary and systems approach toward environmental management and technological transformation.

Sustainability science requires going beyond current legislative mandates to ask new questions, such as: Why aim merely to treat toxic waste when we can limit its creation through the use of more benign materials, more holistically designed and better engineered processes, and the establishment of a regulatory system favoring recycling and reuse? For example, one element of sustainability science—green chemistry—has focused on using energy and materials more efficiently while minimizing waste and toxic end products.

Environmental economist Charles Perrings noted recently that, “Although the development of discipline-based science has been the source of almost all scientific advances of the last century, it has also limited the capacity of science to address problems that span multiple disciplines.” Sustainability science can help.

To inform decision-makers and the public, sustainability science requires a deep understanding of how humans behave and how knowledge is disseminated. We will need improved measurement and accounting of the environment, as well as more effective public reporting, in order to make environmental protection sustainable in the 21st century.

2010 and Beyond
While celebrating its 40th anniversary in 2010, EPA will establish a sustainability science plan that will help the agency mark its 50th year with a new model for environmental protection. EPA research programs are striving to go beyond media-specific needs and provide the interdisciplinary physical, biological, and social science analysis needed to address complex policy issues and define new strategies promoting a sustainable environment. EPA should be one of the leading federal agencies working to establish an integrated, comprehensive science and management approach that can address the complex and urgent environmental problems of today and the future. This will be EPA’s greatest challenge—and opportunity—in the next decade and beyond.

This month’s column was written by Alan D. Hecht, Ph.D., Director of Sustainable Development for EPA.

For more information on the research discussed in this column, contact Deborah Janes, Public Information Officer, U.S. Environmental Protection Agency (R205-01), Office of Research and Development, Research Triangle Park, NC 27711; phone: 1-919-541-4577; e-mail: janes.deborah@epa.gov. Disclaimer: Although this text was reviewed by EPA staff and approved for publication, it does not necessarily reflect official EPA policy.

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**Environment Committee Approves Bill to Cut GHG Emissions**

Bypassing a Republican boycott, Democrats on the Senate Environment and Public Works Committee Nov. 5 approved climate change legislation without amendments by a vote of 11–1, with Sen. Max Baucus (D-Mont.) casting the lone vote against the measure. All seven Republican members of the committee were absent from the vote.

Environment Committee Chairman Barbara Boxer (D-Calif.) said she had little choice but to report the bill (S. 1733) on an up-or-down vote without debating amendments to bypass the Republican boycott of the committee markup, which began Nov. 3. With Democrats outnumbering Republicans 12–7 on the committee, approval of the bill was not in doubt, but the boycott denied Boxer a quorum under committee rules requiring two members of the minority party to be present to amend the bill.

Boxer told reporters that she had expected Sen. Baucus to vote against the bill given his concern that the legislation’s target to reduce U.S. greenhouse gas (GHG) emissions 20% by 2020 from 2005 levels is too aggressive. Baucus has argued that a 20% cut would disproportionately hurt Western states such as Montana, as well as Southern and Rust Belt states that largely rely on coal-fired power plants for electricity.

**Committee Vote Clears One Hurdle**

Boxer pushed ahead with the up-or-down vote after discussing with Senate Majority Leader Harry Reid (D-Nev.) how to end the impasse with Republicans on the committee. Reid and Boxer met the evening of Nov. 4, with Reid recommending the chairman move forward, Democratic committee aides said.

Committee Republicans had vowed to boycott the markup until the U.S. Environmental Protection Agency (EPA) completed a more detailed cost analysis on the legislation.

The committee’s approval of the Clean Energy Jobs and American Power Act clears one hurdle in the drive to find 60 votes to bring the measure to a Senate floor vote. The environment committee, however, is only one of six committees with jurisdiction over various portions of the legislation. But approval by the environment committee—when combined with House passage in June of a similar climate bill (H.R. 2454)—could help guide U.S. negotiators as they head to Copenhagen in December for talks on a new international climate agreement to cut GHG emissions.

**Baucus Wants China to Make Similar Cuts**

Baucus told reporters after the vote that he supports provisions that would trigger a 20% emissions target only if China and other fast-developing nations take comparable action to cut their own GHG emissions. Otherwise, he said he would support a 2020 target in the range of the 14% emissions reduction President Obama offered in his fiscal 2010 budget plan or the 17% reduction included in H.R. 2454 that the House approved in June.

**Revisions by Boxer**

The version of the legislation reported out of the environment committee is the most recent version of the bill, a substitute amendment, or revised chairman’s mark, that Boxer released Oct. 23. The climate legislation was introduced by Sens. John Kerry (D-Mass.) and Boxer Sept. 30.

Boxer’s revised version would codify an EPA proposal to control GHG emissions at stationary sources that emit more than 25,000 tons per year—a proposal known as the “tailoring rule.” Boxer’s substitute also would codify a 25,000-ton threshold for applying operating permit requirements under Title V of the U.S. Clean Air Act (CAA).

In addition, Boxer’s substitute would exempt GHGs from EPA authority to set National Ambient Air Quality Standards under Section 108 of the CAA. EPA, for its part, has said it will not set air quality standards for GHGs. It also would exempt GHG emissions from regulation under Section 112, which governs hazardous air pollutants, and under Section 115, which governs international air pollution.

**EPA Permitting Requirements**

The proposed tailoring rule was published by EPA on Oct. 27 to establish a 25,000-ton threshold for applying prevention-of-significant-deterioration rules to stationary sources of GHG emissions. EPA said that for sources emitting fewer than 25,000 tons, it would delay a decision on applying Prevention of Significant Deterioration (PSD) requirements for...
six years. After that, they could apply streamlined permitting requirements (74 Fed. Regist. 55,292).

Under the CAA, new and modified sources must undergo PSD permitting, during which the state permitting authority determines the Best Available Control Technology (BACT) to limit emissions. The CAA applies PSD to new and modified sources with emissions greater than 250 tons per year.

EPA proposed the tailoring rule with the 25,000-ton threshold to prevent a situation in which thousands of sources each year—including schools, hospitals, and small businesses—have to undergo PSD permitting because their emissions are greater than 250 tons per year.

EPA also proposed applying the 25,000-ton threshold to Title V permitting requirements to prevent more than 6 million sources, including almost 4 million single-family residences, from having to obtain Title V operating permits. The CAA requires sources with emissions exceeding 100 tons per year to obtain Title V permits every five years.

Environmental Group Supports Action

David Bookbinder, senior climate counsel for the Sierra Club, praised the Boxer language. “This is precisely what we’ve been saying makes sense, and I’m not surprised to see it in the bill,” he said. Bookbinder has advocated exempting greenhouse gas emissions from air quality standards and Section 112 hazardous air pollutant requirements.

During an Oct. 29 hearing on the climate bill, Sen. Arlen Specter (D-Pa.) questioned whether language preempting CAA authority over GHG emissions from coal-fired power plants is necessary. Similar legislation (H.R. 2454) passed June 26 by the House would preempt most CAA authority over stationary sources and replace it with an emissions cap-and-trade plan.

Energy industry representative Frank Maisano said Specter may seek to offer an amendment during markup that would preempt CAA authority over GHG emissions. Maisano also said that Sen. Baucus, who has said the bill’s emissions-reduction targets are too aggressive, may offer an amendment to prevent EPA from finalizing the proposed tailoring rule.

Full text of Sen. Boxer’s revised chairman’s mark of S. 1733 as distributed for markup is available at http://op.bna.com/hl.nl?r=Open=thyd-7xhmnx.— by Dean Scott, BNA

EPA Removes Three Provisions from Spill Prevention, Control Rule

EPA said Nov. 10 it is removing three provisions from its revisions to a spill control prevention rule issued in December 2008 “to address a number of issues raised by the regulated community.” The change will revise amendments published in December 2008 to the Spill Prevention, Control, and Countermeasure (SPCC) rule at 40 C.F.R. Part 112 following EPA’s review of comments and consideration of “all relevant facts,” the agency said (73 Fed. Regist. 74,236).

In a draft to be published in the Federal Register, EPA said the final revision will remove three provisions: an exclusion for farms and oil production facilities from the loading and unloading rack requirements; an exemption for produced water containers at oil facilities; and alternative eligibility criteria for certain oil production facilities.

“With these changes, the agency expects to encourage greater compliance with the SPCC regulations, thus resulting in increased protection of human health and the environment,” EPA said.

The rule will take effect Jan. 10, 2010. em
'Driving Environmental Progress: What Can Students do?'
The Push Toward Sustainability

Abstract
Humans will achieve ultimate environmental progress when we learn to live sustainable lifestyles by reducing consumption and waste, increasing efficiency, and growing and/or buying local food. Students are most qualified to lead this initiative as they become increasingly environmentally conscious due to the recent trend in media and business concerning eco-friendly practices. The food we eat accounts for a large chunk of our total carbon footprint, because it travels thousands of miles before it even gets to our plates. We are able reduce our carbon emissions tremendously by sustainable gardening at school and at home. Growing food and becoming independent of mass-produced goods is what sustainable living is fundamentally about, and if you can convey that idea through schools, communities will follow suit.

"We do not inherit the Earth from our parents; we borrow it from our children,"1 and so we cannot blame anyone for the existing environmental situation, however disastrous. At the head of the force is the younger generation, especially students. The key to environmental progress is the decision to bring about change, without blaming "our parents." Many people do not realize how much power they possess in reversing global warming due to two of the many factors of environmental progress that blind them: recycling and saving energy. More important and less recognized, though, is sustainability. Humans will achieve true environmental progress, not when they develop new ways of recycling or a fuel that does not produce toxic emissions, but when we learn to live sustainable lifestyles by reducing consumption and increasing efficiency. Sustainability is a broad term used to describe the process, rather than the goal, of a better life through individual interactions with society, the economy, and the environment.2 The latter can be achieved through different means, including limiting your waste and growing your own food.

The impact of industrial agriculture on the environment is tremendous. The only benefits of this type of mass farming are short-term: affordability and convenience. However, the long-term social and environmental detriments far outweigh these two benefits. Huge amounts of herbicides, insecticides, and fertilizers are used because these farms utilize monocropping, the use of enormous fields of just one type of crop that make it vulnerable to pests. The industrial chemicals used in this method have very negative effects on individual health, as well as the environment. "Nitrogen compounds from Midwestern farms, for example, travel down the Mississippi to degrade coastal fisheries and create a large ‘dead zone’ in the Gulf of Mexico where aquatic life cannot survive."3 Widespread nutrient deprivation and soil deterioration through heavy machinery use destroys the Earth even further. This "is one of the most serious challenges facing humankind as it attempts to feed a growing population."3 There are many, many more environmental impacts, but we must be optimistic, and rather than dwell on all the harm that has already been done, look at what students can do in terms of progress.

Opportunities for students to get involved are everywhere. It has been almost forty years since the first celebrated Earth Day, and awareness continues to increase. Just two weeks ago, PSE&G (Public Service Enterprise Group) held their second annual “GreenFest,” which I eagerly attended. The workshops and speakers were extremely informative and knowledgeable. Mike Azzara, one of the lecturers, spoke about the importance of sustainable and organic gardening, both at school and at...
home. He explained how the food we eat accounts for a large portion of our total carbon footprint, and most people do not realize that their food travels thousands of miles before they buy it at the supermarket. We are able reduce our carbon emissions tremendously by buying locally and even growing our own vegetables. This idea intrigued me, and the next day, I spoke to my biology teacher about starting a garden at school. We already grow quite a few herbs, including rosemary and basil, for the culinary department of the school. It is more achievable than most people imagine, especially if the school has the capacity and student determination to start a garden. Growing food and becoming independent of mass-produced goods is the fundamental element of sustainability, and if you can convey that idea through schools, communities will follow suit.

Before going out and educating family, friends, and communities about the importance of green living, students have to start with themselves. Green living is not only limited to saving energy and recycling, as is the common misconception. Many people that live in houses have backyards and room to plant a modest garden, capable of producing a whole summer’s worth of vegetables for the family and neighbors. All it takes is one or two Saturdays to plant some of the basics: tomatoes, radishes, lettuce, and maybe some herbs. This garden will be cost effective, healthy, and most importantly, environmentally friendly. After all, “There is no act more gratifying, more basic, more liberating, than to coax food from the Earth.” Starting an organic garden requires a little more effort, but it is definitely worthwhile. An organic garden reduces carbon emissions already in the atmosphere, in addition to eliminating the potential carbon emissions you would have contributed by buying your vegetables at the supermarket. Soil with 1% organic matter reduces about .3 lb of carbon per square foot or 2.5 lb with 7.7% organic matter. Now we get to the important point of not only sustainability, but also the reversal of harm, such as global warming.

It’s time we realize there should be no “waste” to recycle in the first place. Humans are the only species that produce useless waste, and we are very rapidly running out of room to put it all. As depressing as it sounds, we need to be optimistic and, as students, spearhead the push for sustainable living. Something as simple as planting a garden has short- and long-term positive effects on you, your community, and most importantly, the environment.

**In The Next Issue…**

**Special Extended Issue!**
For the first time ever, the January and February 2010 issues of *EM* will be combined into a special, single extended issue that will include extra feature topics and articles in addition to all of the regular columns and departments. Look for this special issue to arrive in the mail around the first week of February.

**Energy Efficiency to Achieve Environmental Goals**
A look at some of the programs and opportunities designed to improve energy efficiency, including the U.S. Green Building Council’s Leadership in Energy and Environmental Design program, weatherization programs, and government programs that encourage or require reductions achieved through energy efficiency.

**NAFTA and Transboundary Issues**
An evaluation of the environmental aspects of the North American Free Trade Agreement (NAFTA), as well as what role NAFTA may play in addressing the current transboundary issues involving Mexico, Canada, and the United States.

**Also look for…**
- PM File
- Competitive Strategy
- EPA Research Highlights

…And a special thank you to our volunteer reviewers and issue champions

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Would Like to Welcome Our New Members!

Listed members joined between October 1 and October 31, 2009.

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Aldo Anselmi
David Applegate
Matt Arndt
Mohamad Balagopalan
Jeffrey Baldino
Richard Bartelt
Gary Bartkowski
Brooke Bell
Candace Bell
Yvonne Bell
Robert Berg
Arsh Bina
John Black
Dana Blackburn
Ava-Gay Blagrove
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Blanco Becerra
Megan Bloomer
Christopher Blume
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Camille Bratton
Robert Brown
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Monika Chandra
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Upcoming Webinars

December 10 (2:00 P.M.-4:00 p.m. Eastern)
Coal Combustion Residues and Beneficial Uses
Presenter: Ken Ladwig, Senior Research Manager, EPRI; Bob Dellinger, Director, Materials Recovery and Waste Management Division, Office of Resource Conservation and Recovery (formerly Office of Solid Waste), U.S. Environmental Protection Agency; and Constance Senior, Manager, Engineering R&D, Reaction Engineering International

Join A&WMA to discuss new developments in the storage and disposal of coal ash and advantages to using coal combustion products (CCPs). This timely Webinar will bring together industry experts to cover topics, including current regulations on disposing of coal ash; review of flue gas desulfurization (FGD) by-products and where they come from; safe methods of handling FGD by-products; trace elements found in coal ash and FGD by-products; different uses of CCPs; and the advantages of using CCPs in various applications.

January 14 (2:00-3:00 p.m. Eastern)
Renewable Biomass Energy: Reducing Carbon Footprint and Saving on Fuel Costs
Presenter: Thomas M. McGowan, P.E., TMTS Associates Inc.

Get the information you need to choose and implement an environmentally-friendly energy system designed to meet your organization’s needs. This informative Webinar will discuss all aspects of biomass and alternate fuels, including converting these fuels into energy; alternative fuels’ effect on capital, operating, and production costs; and how using alternative fuels can reduce air pollution emissions. em

JOURNAL

DECEMBER 2009 • VOLUME 59

Listed below are the articles appearing in the December 2009 issue of the Journal. For ordering information, go to www.awma.org/journal or call 1-412-232-3444.

In This Month’s Issue...
Using a Direct Method to Characterize and Measure Flows of Municipal Solid Waste in the United States
Particle Emissions from Ships: Dependence on Fuel Type
Controls on Landfill Gas Collection Efficiency: Instantaneous and Lifetime Performance
Road-Network-Based Spatial Allocation of On-Road Mobile Source Emissions in the Pearl River Delta Region, China, and Comparisons with Population-Based Approach
Fine Particle Receptor Modeling in the Atmosphere of Mexico City
Using Mass Reconstruction along a Four-Site Transect as a Method to Interpret PM10 in West-Central Scotland, United Kingdom
The In-Plume Emission Test Stand: An Instrument Platform for the Real-Time Characterization of Fuel-Based Combustion Emissions
In-Plume Emission Test Stand 2: Emission Factors for 10- to 100-kW U.S. Military Generators
Carbonyl Sulfide Removal with Compost and Wood Chip Biofilters, and in the Presence of Hydrogen Sulfide
On-Road, In-Use Gaseous Emission Measurements by Remote Sensing of School Buses Equipped with Diesel Oxidation Catalysts and Diesel Particulate Filters
Cluster Analysis for Polychlorinated Dibenzop-dioxins and Dibenzofurans Concentrations in Southern Taiwan
Particulate Air Pollution and Health Effects for Cardiovascular and Respiratory Causes in Temuco, Chile: A Wood-Smoke-Polluted Urban Area
Call for Abstracts

2010 Power Plant Air Pollutant Control Mega Symposium
August 30-September 2, 2010
Baltimore, MD
Abstract deadline: January 11, 2010

The internationally popular Mega Symposium returns in 2010 to address issues related to coal-fired power plant air emissions through the combined efforts of four key industry players: the Electric Power Research Institute, the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the Air & Waste Management Association. This eighth Mega Symposium will showcase the latest development and operational experience with air pollution controls from fossil-fired power plants in light of the evolving environmental regulatory directions. The symposium will look at state-of-the-art methods for reducing sulfur oxides, nitrogen oxides, carbon dioxide, particulate, mercury, and hazardous air pollutant emissions from fossil-fueled boilers. Presentations are also encouraged on experience with the impacts of plant cycling on air pollution controls. To view the full call for abstracts, visit www.megasymposium.org.

15th World Clean Air Congress of the International Union of Air Pollution Prevention Associations (IUAPPA)
September 12-16, 2010
Vancouver, British Columbia, Canada
Abstract Deadline: March 12, 2010

The theme of the 2010 IUAPPA Congress, “Achieving Environmental Sustainability in a Resource Hungry World,” recognizes the need for holistic management approaches to effectively mitigate potential water, food, energy, and environmental challenges. This meeting will bring together specialists from academia, industry, consulting, environmental advocacy groups, and government to present innovative ways to improve air quality, reduce greenhouse gas emissions, and minimize environmental impacts. The program will examine international-, national-, and local-scale issues facing both emerging and developed economies. To view the full call for abstracts, visit www.iuappa2010.com.

For more information about the conferences on this page, go to www.awma.org/events.
Daniel L. Todd, QEP, CHMM
President
Air Quality Services, LLC
Evansville, IN
East Central Section; Indiana Chapter
A&WMA Member Since 1977

What inspired you to become an environmental professional?
Todd: This was an evolutionary process. In 1974, I was given an opportunity to get into ambient air monitoring, working for a local agency; it was in the early days of development. In short order, I was motivated to pursue a college degree that incorporated the science, engineering, and policy aspects of environmental management. I was—and still am—fascinated by the interrelationships.

What advice would you give to students and/or young professionals just starting out in the field?
There is no doubt that our environment is in much better shape today than it was 40 years ago; it can be gratifying to be a part of that effort. Is the job complete? No. That said, my advice to students and young professionals just starting out in the field would be to pay close attention to the science and be wary of political posturing.

What does A&WMA membership mean to you?
It has been an excellent source of education and training. Also, through my association with A&WMA, I am exposed to top-notch professionals with various viewpoints.

What was the best A&WMA conference you’ve attended?
The first A&WMA conference I attended just blew me away with all of the opportunities for learning. Of course, I have a special place for the 2004 Annual Conference & Exhibition held in Indianapolis, when I served on the Local Host Committee; seeing the background efforts and the dedication of the people involved really opened my eyes to the level of effort required to host a conference of this size.

What are your proudest accomplishments as an environmental professional?
Some of my proudest accomplishments include achieving Qualified Environmental Professional (QEP) certification; co-authoring two chapters (on air pollution and on operating a business) in the Hazardous Materials Management Desk Reference; and, while difficult to explain, I get real satisfaction from being part of a client’s solution.

What’s the single biggest environmental problem facing the world today?
I would say personal and polarizing “debates” of the issues, where political agendas guide the interpretation and use of “science.” It often seems that there is a lack of respect for alternate views or even questions.

How do you like to let off steam?
My favorite pastime is fly fishing. I also enjoy reading about American history and visiting with my grandchildren. (Dan is pictured above enjoying his favorite pastime.)
Galicia

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