



# Environmental Planning Journal

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Winter

**Feature Article by Timothy Nolan of the Sustainable Communities & Eco-Industrial Development in the Minnesota Office of Environmental Assistance**

***Applied Eco-industrial Development, A Pathway to a New Materials and Production Economy: Transition to an ecology driven economy***

Throughout the industrial age economies were based on industrial models that require tremendous levels of nonrenewable inputs (energy, materials, chemicals, water) to create quality-of-life improvements for many, wealth for a minority, and a lot of outputs, including waste, toxic emissions, and pollution. This one-way flow of materials through linear systems of extraction, processing, manufacturing, distribution, consumption, and disposal is putting major—and ultimately unsustainable—stress on local and global environmental systems.

It is said that there is a New Economy emerging based on knowledge verses resources. It relies on flexibility, speed, quality and networks. It is about applying knowledge and new ways of doing business to a range of products and services. The New Economy is based on productivity including maximizing economic and human capital not just lower costs and cheap natural resources. Players in the New Economy value quality of life and prefer to work and live in communities that provide diverse amenities not the least of which is a healthy and attractive environment. Protecting the environment is seen as being in the long-term interest of businesses and communities who hope to grow and ultimately be sustainable. Natural capital will continue to increase in value and will in many ways become a major driver in this New Economy. Businesses and communities who

are able to embrace and harness the full value of natural capital will, at least in the long-term, gain significant competitive advantage over those who don't. In a sense, ecology must drive the New Economy as opposed to economy over ecology. Thus, sustainable industrial development will out of necessity become the norm rather than the exception.

A new materials and production economy embodied in sustainable industrial development represents a shift from our old industrial model to one that demands that industries simultaneously support the economic, social, and environmental health of the community and region.

To be sustainable, industrial development must do more than create jobs and tax base while meeting minimum standards for environmental protection, wages, and employee protection. Sustainable industrial development is cleanly integrated into the community to efficiently use local resources, work syner-

*Continued on Page 3*

**In this Issue:**

Applied Eco-Industrial Development-Pg.1  
 Notes from the Chair / Division Work Program-Pg. 2  
 In My Opinion, China and the Kyoto Protocols-Pg. 5  
 Indoor Air Pollution Planning for School Bldgs-Pg. 8  
 Green Roof Infrastructure & Smart Growth Goals-Pg.10  
 Examples of Eco-Industrial Development-Pg.11



**Phillips Eco-Enterprise Center** Minneapolis, Minnesota  
 EID features include: sustainable building design, brown-fields redevelopment, Environmental business cluster, Ground source heating & cooling, and 100% on-site stormwater retention

## Notes from the Chair

Rather than writing a full column this month, I am including a copy of the Division's proposed work plan for the upcoming year. I encourage you to review it and to contact me with any comments or suggestions. Or perhaps even better, let me know if you have any interest in volunteering for any of the committees to be established to work on the items in the plan.

We will be discussing this in detail at our Annual Business Meeting at the San Francisco Marriott (Sierra K Room) on Tuesday March 22, 2005 starting at 7:00 a.m. Breakfast will be served and everyone is invited to attend and participate. We look forward to seeing you there.

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## Environment, Natural Resources, and Energy Division American Planning Association 2005 - 2006 Work Program

According to the by-laws, there are 3 major purposes of the ENRE Division:

1. Advance the theory and practice of environmental, natural resource and energy planning as sub-disciplines of the planning professions.
2. Promote the incorporation of the best environmental, natural resources and energy planning practices in the work of generalist planners and other planning sub-disciplines; and
3. Promote the adoption of scientifically sound and effective policies to promote the protection of the environment and the wise use of natural resources and energy by the American Planning Association as an organization and by APA's members as individuals.

Based on the above three purposes, the following is the mission statement for the Division's Strategic Plan. The mission statement should define the purpose of the organization - describing who are we, and what do we do. The vision statement expresses what the future will be if the mission is fulfilled.

### **Mission Statement**

**The ENRE Division's mission is to promote sound environmental, natural resources and energy planning policies among individual members of APA, the general public, and within the planning profession and communities of all scales.**

### **Vision Statement**

The ENRE Division envisions a future in which we have forged partnerships with our colleagues, citizens, and non-governmental organizations to work towards a more sustainable way of life. We promote the understanding and appreciation for the importance and complexity of the natural environment and work with elected and appointed officials and professionals from many disciplines in solving the many complex natural resource and energy-related problems that are before us. Finally, we advance the science and art of planning, adhering to our code of ethics in achieving our mission.

### Goals and Work Program for the period April 1, 2005 through April 30, 2006

The goals for this work period reflect the annual work plan for the Division. A number of the goals are operational in that they are expected to be accomplished each year. Other goals are broader in nature and will require multiple years to accomplish. For the latter, phase I of the goal is identified in the discussion section. A budget will be proposed that provides adequate funds to achieve these goals.

*Continued on Page 6*

*Continued from Page 1*

gistically within the industrial and commercial economy, and continuously improve the quality of life for community residents.

### *Industrial development and sustainability*

Sustainable industrial development is a subset of sustainable development and occurs when existing and new industrial facilities and processes are designed to operate in ways that achieve not only economic performance but simultaneous higher performance in environmental and social considerations. Such development addresses both the short-term and long-term economic costs of environmental degradation—solid and industrial waste, air pollution, surface and ground water pollution, toxics in the environment, natural resource depletion, land degradation, and negative human and ecosystem health impacts. The inherent benefits of high performance industrial development are not only improved environmental performance but also economic as well as competitive advantages for the enterprises and communities involved.

### *Adopting principles of industrial ecology*

Industrial ecology involves designing businesses and groups of businesses as if they were a series of interlocking ecosystems, which interact benignly with the environment. Industrial ecology uses the natural environment as a model for solving environmental problems and for creating the most efficient industrial processes. In a sense, industrial ecology views the supply chain components within an industrial system as symbiotic, rather than independent, each contributing to an efficient system that generates minimal by-products and pollutants.

For example, in nature, every “waste” is used by some other organism within the ecosystem. In an eco-industrial development, this means that first a business minimizes its resource usage; any remaining waste is used as a resource by another business within the system.

One aspect of industrial sustainability is embedded in the concept of eco-industrialism, or the use of industrial systems that go beyond minimizing environmental degradation and actually enhance the local, regional, and global environment.

### *What is eco-industrial development (EID)?*

Eco-industrial development is a network of industrial and commercial businesses that are designed and organized to interface benignly with the local environ-

ment—to cooperate with each other and with their communities to efficiently use resources, which leads to economic gains, eliminates pollution, and enhances human and natural resources.

This results in a network of relationships between: (1) core businesses within a given development or industrial park; (2) core businesses and the community or region; or (3) core eco-industrial businesses and other regional businesses such as materials, energy, or component suppliers that may result in an industrial cluster.

An eco-industrial development reflects the character of its surrounding community and integrates its economic, environmental, and social goals. An EID is connected to the community through enterprises that have environmentally sound facilities, production practices, technologies, and products. EID considers the local industrial input resource base, energy resources, and material flows as well as compatibility with existing industries and local businesses. Typically, job creation is pursued in the context of strengthening a community, while enhancing quality of life and protecting local natural resources.

In contrast to current industrial development patterns, an eco-industrial approach aligns industrial systems with ecological systems, resulting in the most efficient industrial processes that: (1) systematically examine material and energy flows throughout industrial supply chains; (2) maximize efficient use of resources, energy, and by-products; (3) minimize impacts on the environment by moving toward zero emissions; (4) apply a life-cycle approach to go beyond waste minimization, pollution prevention, and eco-efficiency to address the cumulative impacts of development; (5) integrate sustainable design features; and (6) maximize use of renewable energy and materials.

EID may involve existing or new commercial and industrial development. Such development can be urban or rural and include: renewable energy-based business parks; environmental technology business clusters; inter-company networks; sustainable land-use; vertically integrated resource recovery; bio-based production enterprises; sustainable buildings and site designs; or other amenities shared by businesses.

### *Benefits of eco-industrial development*

- To businesses: Cost savings through resource efficiency, competitive advantages, diminished need for regulation, green and socially conscious market demand, improved employee health and productivity, and enhanced supply chain relationships
- To communities: Higher quality job creation and retention, compatibility with community goals, en-

*Continued on Page 4*

hanced business recruiting, and value-added to the local economy.

- To the environment: Cleaner technologies, more efficient use of resources, fewer emissions, reduced cleanup and regulation costs, and greater energy security through increased use of renewable energy.
- To commerce: Enhanced global economic competitiveness through new economic development; direct and indirect jobs, business expansion, and increased revenue and gross economic activity.

### *How to approach eco-industrial development*

EID is about systemic industrial change that addresses overall system efficiency versus facility or process efficiency. Rather than focus on isolated components in an industrial system all components are viewed as interconnected. In addition, applying an eco-industrial approach requires a complete understanding of material and energy flows, inputs and outputs throughout the system and how each component within this system affects these flows. As compared to most current industrial systems that are linear and open (discharging emissions and waste) an industrial ecology model is cyclical or closed loop. Ultimately an eco-industrial system results in an overall reduction in material and energy inputs and approaches near zero waste and emissions outputs. In addition, material and energy inputs are renewable based while toxic chemicals are designed out of the system. In an eco-industrial system there must be intercorporate collaboration where enterprises become civic partners and the focus of resource productivity is the community of businesses rather than an individual business.

### *Elements of an eco-industrial development approach*

Applying EID can create win/win scenarios for communities, businesses and environmental quality. There are many forms of EID that include multiple strategies to achieve success. There is no “one size fits all” approach. It will take a combination of community will, leadership (at least a champion or two), resources from different partners, and an engaged business sector to gain the competitive advantages that can result from successful EID. Other elements of EID can include:

- A cluster-based economic development strategy that geographically concentrates interconnected companies, suppliers, service providers and associated institutions to enhance competitiveness, improve productivity, foster innovation and create new ventures.

- A system of businesses whose production processes are linked in such a manner as to reduce or eliminate production waste, inefficiency, and pollution.
- An industrial development strategy designed around sustainably using a local resource to capture a diverse range of value-added processes and businesses.
- An industrial location or facility designed to meet high performance standards that significantly exceed minimum code performance standards.
- An industrial location or facility that is actively managed to meet performance standards for reducing nuisance, pollution, production and energy waste, and other eco-industrial goals. The management includes targeting particular types of businesses, and excluding businesses that cannot meet performance standards.
- An industrial development strategy that deliberately accommodates the transportation and housing needs of workers.

### *Conclusion*

Optimal eco-industrial development goes beyond environmental management systems, eco-efficiency or even the concept of eco-effectiveness. Facility, process or product improvements must be addressed within a larger system that considers affects on local ecosystems and communities. Relationships and behavior between businesses and between businesses and communities is key to creating eco-industrial developments. It requires true corporate responsibility along with cooperation between many levels of government. Eco-industrial development is means to a new way of doing business and provides the opportunity for innovation, new alliances, new technologies and new processes and products.

Sustainable development is a continuum and must include a systems approach, interdisciplinary thinking, and a combination of methods and interests working together. Current trends such as global warming, natural resource degradation, and resource depletion combined with the ever increasing economic challenges that communities and businesses must overcome requires that we begin to reorient our industrial systems. Successful eco-industrial development can provide a pathway to “New Materials and Production Economy.”

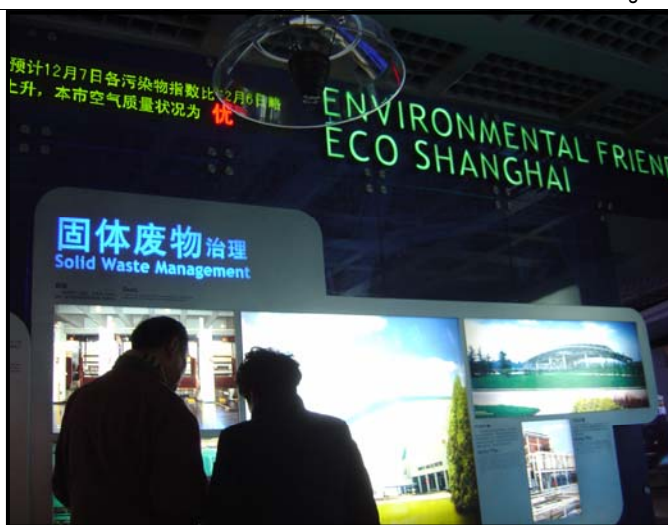
*See page 11 for more EID examples*

### In My Opinion, by Tyler Frazier, AICP

Located in a monument to the urban development of Shanghai, China is the largest model of an urbanized area in the world. The Urban Exhibition Building shares Renmin Square with the Municipal Government Headquarters and the City’s Theatre and Museum of Art. It includes a massive testament to the history of Shanghai and also presents the city’s comprehensive, long-range urban plan, including a major component dedicated to sustainable development, environmental planning and the process for making “Eco-Shanghai.” Articulated amongst these plans, are initiatives to improve air, water, and land quality. These plans are available to anyone in the traveling public for an admission fee of about seven dollars.

Visiting this Exhibition Hall punctuated my realization that China is not only an industrious, energetic, and vibrantly growing country, but it is also in the process of an intense transformation that involves the synthesis of pragmatism and idealism. The People’s Republic of China is one of the many transitioning countries that is a signatory of the Kyoto Protocols, a noteworthy commitment. These protocols, which have recently gone into effect, leads me to ask, how can a country such as China, with its massive population and projected growth commit to reducing GHG emissions to 1990 levels?

In the feature article, the author speaks of a “necessary shift to sustainable development” and it is obvious that China is acting to face exactly this challenge. The Urban Exhibition at Shanghai testifies not only to the municipality’s dedication to sustainable development, but also to the fact that the central government is soundly in step with local policy, an accomplishment even more remarkable than the model itself.



*Above:* The solid waste component of the “Eco Shanghai” sustainable development plan. This publicly available long range planning document is presented in a manner that is easily understood by the public, and it is not only interesting, but informative. Many components are dedicated to sustainable development, including comprehensive air, water, and energy use plans.

*Below left:* the largest model of an urbanized area is located in the Urban Exhibition Building on Renmin Square in Shanghai, China—a remarkably accurate work inclusive of an incredible amount of detail.

*Below right:* One of the many urban parks found throughout the city of Shanghai, China. This particular park is located near Huihua, Maoming, and Shanxi Streets, an area that is famous for its luxurious hotels, excellent restaurants, and energetic night life, a favorite hot-spot amongst locals and westerners alike. Numerous parks, pedestrian malls, and a massive subway and bus network make Shanghai a community that is easily (and best) seen on foot. Identification signs are generally found in both Mandarin and English.



***1. Maintain a high quality web site that provides useful, timely information to ENRE members as well as the public on issues related to natural resources and energy policies.***

Discussion

The web master, Tricia Lease, continues to maintain the web site. The site is maintained and updated on a regular basis. A small, quarterly stipend is provided for these efforts. Suggestions for content is provided by a small committee headed by Ian Crelling. The site would continue to include articles of interest to practitioners in the field and allied professions, a calendar of events, the newsletter, ENRE/APA related announcements (i.e. student fellowship), and legislative and regulatory news.

At its next business meeting, the Division will consider the option of having the web site managed by APA and linked through the APA web site. This will save the Division money while making web site maintenance and content updating easier.

***2. Improved tracking of natural resources and energy-related bills in Congress by expanding the ENRE Legislative Committee.***

Discussion

There has been increased interest in this topic among ENRE members. A Legislative Committee should be re-established after several years of dormancy. There are a number of environmental matters on the APA legislative priorities list, to be adopted by the APA Board of Directors at the San Francisco meeting. These include transportation issues as they relate to the environment (air quality), oceans and coastal development, water infrastructure, land conservation, comprehensive energy legislation, endangered species, and sustainability. Division involvement enhances APA's implementation of its policy guides, many of which address concerns of interest to the Division.

The Committee would assist the Washington office of APA in tracking legislation of interest to our membership, and could alert members around the country about actions to be taken in support of APA's legislative agenda. Articles will be written for the ENRE newsletter.

***3. Prepare a high quality quarterly newsletter with at least one original article in each issue.***

Discussion

High quality newsletters continue to be produced on a quarterly basis. A typical issue includes articles covering a wide range of topics, along with Division

information, a calendar, and a column from the Division Chair. The Division has a new newsletter editor, Tyler Frazier, who is currently working on his second issue. A small quarterly stipend has been provided for his efforts. He is actively seeking new and relevant material and future issues may have topical themes.

The Division continues to identify ways to reduce costs in producing and distributing the newsletters. These efforts have generally succeeded, although some glitches have occurred that were out of our control. They are addressed quickly and the newsletter is delivered on a timely basis.

***4. Annually develop at least two National APA conference sessions on current natural resources/energy topics, with quality speakers.***

Discussion

Two sessions have been developed for the national conference in San Francisco in March, 2005 and at least that number of sessions will be submitted for the 2006 conference. A committee was established to solicit session proposals and review them. This committee was the point of contact with APA staff for the session submittals on behalf of the Division. Greater efforts should be made to coordinate with other Divisions in the development of sessions, especially to create tracks that would be of interest to members. It is also possible that a full day could be devoted to ENRE issue sessions at a future conference.

To that end, ENRE has been involved with a Divisions Council forum on airports as an important player in regional planning issues. This effort is led by the Transportation Division. A half-day session at the 2004 conference kicked-off that effort, which will lead to additional sessions at APA conferences and some written products as well (potential PAS report, policy guide, etc.).

Food as a planning issue was proposed by ENRE as a major theme for the Divisions at the conference in San Francisco. A seven session track was incorporated into the program, an endeavor that was coordinated by Past-Chair Deanna Glosser, AICP. Again, a written product may be the final outcome – perhaps as a PAS report.

***5. Assist National APA in the development of new or refinement of existing policy guides as needed.***

Discussion

As National APA revises existing or develops new policy guides, assistance is requested of Divisions with relevant expertise and interest. During the past year,

*(Continued on page 7)*

ENRE assisted APA in the development of a Policy Guide on Energy, which was adopted in Washington, DC. Another policy guide topic being explored is air quality. A briefing paper will be presented at the San Francisco Chapter Delegate Assembly. Division Chair, Ralph Willmer, AICP is coordinating the establishment of a Task Force for the development of this policy guide and it is anticipated that there will be interest from other APA Divisions.

Ralph Willmer is a long-time member of APA's Legislative and Policy Committee and acts as liaison between the Committee and the Divisions Council.

**6. Establish a relationship with APA's Student Representatives Council (SRC) and work with them to help achieve ENRE's mission. Specific projects include:**

- **Promote ENRE student membership - possibly linking the ENRE web site with the SRC site, providing updates for their newsletters and vice versa.**
- **Continue the Student Fellowship program.**
- **Develop a student mentoring program.**
- **Discuss other needs for possible projects with the SRC.**

#### Discussion

The Student Representatives Council could be an important partner. We could promote both the ENRE mission and assist SRC members interested in environmental or energy-related issues. The Division has a sizeable balance in the treasury and needs to identify beneficial projects to undertake. The Student Fellowship program is developed and being advertised on the ENRE web site. A fellowship was awarded for the 2004 – 2005 school year. It is proposed that this program continue.

Greater efforts need to be made to work with the SRC to achieve items a, c and d since not much progress has been made in the past year. However, Ralph Willmer signed onto the AICP mentor program and has met with two graduating students, one of which has already found a job!

**7. Work to develop partnerships with professional organizations with related interests to ENRE.**

#### Discussion

There are numerous organizations that have similar interests and goals to ENRE. Some have reached out directly to ENRE and others have been contacted by Division leadership. Examples include the National Association of Environmental Professionals, the Green

Roofs for Healthy Cities, Global Communities Initiative, Organization of Wildlife Planners, Society of Wetland Scientists and other organizations addressing energy, sustainable development, and environmental issues.

ENRE has been asked to sponsor conferences, write articles (or accept them in our newsletter), participate in legislative meetings, and lend our expertise. The energy policy guide has received a great deal of attention – perhaps more so than other policy guides. As another example, we co-sponsored the Sustainable Communities 2004 Conference this July in Burlington, VT. APA and ENRE were given a substantial role in organizing the conference, which included a closing session on the role planners should play in sustainable communities.

More details on this aspect of the ENRE work plan are discussed in Action Item 8 below.

**8. Help APA take a leadership role in planning for sustainability.**

#### Discussion

No issue seems to have generated more interest among active ENRE members than sustainability. The Division believes this is good for APA on a number of fronts. First, it is a classic example of implementation of a policy guide (Sustainability – adopted in April 2000). APA and ENRE members have been using the policy guide as the basis for some of its recommendations to the Executive Director regarding future actions the organization should be pursuing in this arena. Second, ENRE has co-sponsored several events and conferences with allied organizations, which is to be advanced further in this coming work program. Third, ENRE members have spoken at a number of these conferences and have gained recognition for their contributions.

ENRE has recommended that APA play a leadership role in this effort, which has been forwarded to the President-Elect, the Executive Director, and the Legislative and Policy Committee. Specifically, these efforts include:

- Participation in an eco-municipality initiative, which will focus on developing a demonstration project in Ashland, MI and will lead a five-year effort to create sustainable communities in the U.S. ENRE is working with the APA Board and the Legislative and Policy Committee to participate in this event, starting with a June 2005 meeting.
- Participate in the U.N. Decade of Education for Sustainable Development. There will be a session at the National Conference that will discuss how APA can use this as a framework to pursue

educational activities within communities, among targeted interest groups, or on a national stage.

- It is hoped that sustainability can be a future APA “supertopic”, which could include conference sessions, training, a PAS report, and having the issue highlighted on the website.
- Create university-level curriculum on the topic.

### ***9. Parlay Division expertise into outreach, speaking, writing, and legislative activities.***

#### Discussion

ENRE should be the place APA staff turns to when they need expertise to address legislative issues with Congressional staff; when allied organizations need a speaker for their conference; when APA seeks an individual to talk with the press; and when APA chapters need similar services. More effort needs to be focused here to make this a reality, although APA staff has called on Division members more often to assist on particular legislative and regulatory issues.

### ***10. Conduct a membership survey***

#### Discussion

It has been a number of years since the last time ENRE conducted a membership survey. This work plan is fairly ambitious and it is believed to be consistent with the interest of the Division’s more active members. However, it is important to communicate with our membership on a periodic basis to ensure we are moving in the right direction. Russ Forrest, AICP has volunteered to assist in this effort and APA can assist in creating the survey and tabulating the results.

### ***11. Build Division membership.***

#### Discussion

ENRE should prepare a membership brochure. This has been an item that needs to be pursued further. Previous efforts have not moved forward.

**The modern majesty consists in work  
- Carlyle**

### **Indoor Air Pollution Planning for School Buildings** by Muffadal Attarwala

Over the last few decades, the United States government has considerably strengthened the Clean Air Act in order to better regulate the emissions of pollutants from stationary and mobile sources. Although outdoor air quality has improved as a result, indoor air quality has been on the decline due to better insulating techniques. Many hazardous pollutants that remain diluted in the atmosphere accumulate in buildings

over time by entering through the heating, ventilation, and air conditioning system. Poor indoor air quality is also caused by indoor biological and synthetic sources of air pollution such as mold, pressed-wood products, cleaning agents, and paint.

Only recently has indoor air quality in schools become a primary concern. According to the United States Environmental Protection Agency, children are more susceptible to air pollutants because they breathe 50% more air per pound of body weight than adults. As a result, children will experience more adverse health effects when exposed to air pollutants than adults. In the last few years, studies conducted in several countries have determined that exposure to air pollutants from both outdoor and indoor sources causes a variety of respiratory problems. Additional research conducted in the United States and other industrialized nations have found that schools located near outdoor pollution sources exhibited poorer levels of indoor air quality.

Once the consequences of exposure to air pollutants became known in children, research began to focus on the correlation between school buildings located near outdoor air pollution sources and indoor air quality. Several studies concluded that schools located near major roads showed high levels of transportation related pollutants indoors such as nitrogen dioxide, particulate matter, and carbon monoxide. One study went into further detail by concluding that schools located closer than 350 meters from a major road or highway had an increasing risk for indoor air pollution. Another study found that a school located downwind from a major road or highway with heavy traffic patterns led to poor indoor air quality even if the school was located farther than 350 meters from the pollution source. In addition, schools located near agricultural fields exhibit high levels of pesticides in the soils surrounding the schoolyard.

One aspect that these studies mentioned above have failed to address is that school buses are the closest source of outdoor air pollution for school buildings. In 2003, The USEPA stated that the diesel exhaust from school buses idling in loading zones can enter the school building through the outdoor air intake and increase the risk of lung cancer in children. As a result, many states have enacted anti-idling laws that prohibit school buses from idling while waiting to pick up or drop off students. However, this law is not enforced by the USEPA and no effort has been made by the agency to examine whether schools are following the strategies outlined by the USEPA.

Although outdoor sources of air pollution are a concern for school buildings located near roads, industries, and agricultural fields, many risk factors exist inside schools that can lead to poor indoor air quality. In studies of human exposure to air pollutants conducted by the USEPA, indoor levels of air pollutants were found to be 2 to 5 times higher than outdoor levels. In response to the potential risk factors present in schools that may cause indoor air pollution, the USEPA created the *Indoor Air Quality Tools for Schools* kit. This comprehensive tool provides school administrators with the information necessary to design high performance schools through the repair, renovation, and maintenance of existing facilities. Poor operation and maintenance of the HVAC

system, indoor biological and synthetic sources of air pollution, and the presence of buses idling on school property are all risk factors that undermine the indoor air quality of a school building. The *Indoor Air Quality Tools for Schools* kit enables schools to create a plan to identify and mitigate risk factors found in schools pertaining to the four categories mentioned above.

The HVAC system regulates the air movement through a building and prevents the accumulation of pollutants inside a building over time. The USEPA (2004) advises schools currently under construction to place their air intake away from any nearby roads. The air intake is part of the HVAC system and brings fresh air into the school building, providing outdoor air pollutants a pathway into a building. The HVAC should also be designed with the ventilation ducts present in classrooms located at the top of the room because most air mixing occurs in the top portion of the room. Doorways should be designed so that there is space between the bottom of the door and the floor to allow air to flow from one room to the next. The space between the door and the floor should be large enough to take into account any carpeting that may be installed. This carpeting could block the flow of air underneath doors if the space underneath the door is not adequate. Lastly, changes should not be made to the original design of the interior of the building. Tearing down or putting up walls to alter the design of a room can seriously impair the flow of air through the building.

For schools that have already been established, schools can take several steps to ensure that the HVAC system is working efficiently. First, teachers should ensure that any ventilation ducts in their classrooms are not blocked by books or similar items. In order to properly maintain the HVAC system, air conditioning drain pans should be cleaned frequently to prevent the buildup of bacteria and mold in the HVAC system and the cooling towers should be inspected quarterly by a trained professional to remove any algae growth. Filtration systems should be replaced quarterly instead of just twice a year and boilers should undergo monthly inspections to ensure that flue gas is not leaking into nearby ventilation ducts. Finally, the HVAC system should be turned on at least 90 minutes before class to ensure that the air is properly ventilated. Each of these steps ensures that the HVAC system is operating efficiently and allowing air to flow through the building to prevent the buildup of pollutants in the indoor environment.

Even if the HVAC system is running optimally, mold growth in schools can lead to poor indoor air quality and damage a school's infrastructure, warranting costly repairs. Many different types of molds exist and all have the potential to cause a variety of health problems such as the prevalence of asthma, respiratory tract infection and disease, allergic reactions, headaches, eye and skin irritation, fatigue, dizziness, nausea, and even death. Molds require water to survive and grow on virtually any organic surface such as paper, wood, carpet, and insulation. As a result, the excessive spread of mold throughout a school can deteriorate the walls, floor, ceiling, and carpentry of the building.

The single most important step to stopping mold growth is to ensure that moisture problems found in the school are addressed immediately. Carpets that have been cleaned

should be dried immediately and not allowed to dry overnight. Leaky plumbing and leaks in the building infrastructure should be fixed as soon as possible and the indoor humidity of the building should be set between 30-50% if possible. If significant mold problems are identified, the school should contact a professional mold remediator to correct the problem. The school should never attempt to repair a mold problem due to the likelihood that several mold spores will be released into the school atmosphere, causing adverse health effects in children. Lastly, the school must regularly perform HVAC inspections and maintenance in order to catch mold problems as early as possible. Schools that follow these steps will reduce the amount of indoor air pollution and infrastructure damage caused by rampant mold growth.

Synthetic sources of indoor air pollution arise from the use of pressed-wood products, cleaning agents, pesticides, and paint. Pressed-wood products are artificially created by the fusion of wood chips and strips under high pressure. As a result, pressed-wood products release chemicals into the air that can cause minor respiratory irritation, long-term respiratory cancer, and heart failure. Cleaning agents, pesticides, and paints all release fumes into the air that can cause irritation of the respiratory tract, eyes, nose, and throat.

Chemical fumes arising from synthetic sources are the easiest risk factors in schools to identify and mitigate. However, they are often overlooked due to ignorance on the part of school officials and the carelessness of janitors. For example, many school administrators purchase pressed-wood furniture because the product is often cheaper than conventional furniture. Another example involves the deactivation of the HVAC system during the summer when maintenance work such as painting and cleaning the carpets occurs. As a result, chemical fumes that arise from these synthetic products accumulate in the school over time. For this reason, schools should keep their HVAC system on whenever any maintenance activities are to be performed. In addition, any chemical agents that are used in the school should be properly sealed and stored in a ventilated closet to avoid the release of hazardous vapors into the air. These risk factors found in schools are the least costly to implement and can help schools improve their indoor air quality.

The USEPA as well as other independent researchers have provided schools administrators with the planning tools necessary to ensure that the indoor environment of their schools are a healthy place for children to learn. Several studies regarding the impact of pollution on the health of children and the correlation between indoor air pollution in schools and the proximity of schools near a major road or highway have provided the framework for the creation of these tools. It is up to the school officials to take responsibility for indoor air quality problems occurring in their schools and use the tools provided to them to investigate and mitigate risk factors. By making plans to ensure the environmental safety of their schools, administrators become role models for other buildings failing to meet indoor air quality standards. Commercial, industrial, residential, and retail buildings can all learn from the guidelines presented in the *Indoor Air Quality Tools for Schools* kit in order to solve their own indoor air pollution problems.

## **Green Roof Infrastructure Helps to Implement Goals of Smart Growth** by Angela Loder and Steven Peck

Smart growth attempts to address some of the negative outcomes of the post World War II style of development, including a loss of greenspace, deteriorating downtown cores, and strained and ageing infrastructure.

By using previously unused urban roof space to provide multiple social, economic, and environmental benefits, green roof infrastructure offers a tangible means to overcome barriers to achieving Smart Growth. Most importantly, green roofs can contribute to attaining four of its major goals: support of cost-efficient infrastructure, infill development, the development of healthy communities, and biodiversity conservation.

The ability of green roofs to help mitigate the urban heat island effect, as well as substantially reduce and filter stormwater run-off, is becoming well known. Both of these can significantly improve municipal infrastructure by simultaneously providing reduced heating and cooling demand loads and energy costs as well as a reduction in combined sewage system overflows. Combined with the potential for cities to leverage private funds for green roof installation through the use of incentives, green roofs offer the real possibility of helping cities achieve more cost-efficient infrastructure called for by Smart Growth advocates.

A lesser-known benefit of green roofs is their use in furthering Smart Growth's goal of infill development and the support of healthy communities. Preliminary research indicates that green roofs can not only help to make urban communities more attractive places to live, but that they can significantly lessen community resistance to infill development, a substantial barrier to its implementation. The problem is two-fold. On the one hand, infill development is often associated with increased traffic congestion, loss of greenspace, and loss of neighbourhood character and property values by existing residents. On the other, the potential for land-use conflict between greenspace and infill development in urban areas, can result in a lack of greenspace that reinforces the image of cities as polluted, noisy, and dirty places to live, further hampering efforts to implement densification and infill. Green roofs have been shown to mitigate against these barriers in two ways. First, the addition of greenspace has been shown to contribute to increased productivity and well-being for those

nearby. Part of this is due to biophilia, our deep attachment to, and need for, natural surroundings, which has been shown to influence worker productivity, health, well-being, and sense of place - that ephemeral quality so essential to the success of a city and the communities within it. Secondly, when green roofs are part of a proposed infill development, they can often help reduce community resistance. Experience has shown that though neighbours often initially object to proposed increases in density, well-designed projects can alter their perception and even turn them into advocates of infill.

As part of this trend, the provision of green roofs have been used to sweeten a development proposal to reluctant communities or to give something back to the community in exchange for the increased density or unpopular building project. For example, at the suggestion of the City of Toronto, a proposed infill project at Ryerson University for a new engineering building investigated the possibility of adding a green roof. It was subsequently found that this was a deciding factor in appeasing neighbouring residents within a condominium who were opposed to the project. By offering greenspace to communities as part of infill development, green roofs can both help mitigate community resistance to infill and provide biophillic improvements to the overall living environment.

Lastly, the addition of greenspace without the usual land-use conflicts has shown promise in re-creating habitat in urban areas, an essential part of Smart Growth doctrine and the health of the city. Research conducted by *English Nature* and Dr. Stephan Brenniesen (2003) has demonstrated the ability of green roofs to provide habitat for birds, invertebrates, and native plant species. The call for the preservation of biodiversity within cities requires a change in our conception of scale, and a re-thinking of our idea of urban nature and space. Though not a complete replacement for lost wilderness, green roofs can help to mitigate the impact of ever expanding urban boundaries.

By using normally wasted roof space, green roof infrastructure has considerable potential to provide additional greenspace for healthier cities, biodiversity restoration and protection, and cost-efficient infrastructure while helping to reduce traditional neighbourhood resistance to infill development. Roofscapes need to become an important component in the toolkit of planners seeking to guide the development of healthier and more sustainable communities.



## EXAMPLES OF ECO-INDUSTRIAL DEVELOPMENT (EID)

**Sustainable Technologies Park** Cape Charles, Virginia  
EID features INCLUDE: EID codes & covenants; business rating system provides financial incentives for environmental management; sustainable land use and building design; thin film solar panel roof; and adjacent wind farm.



**Londonderry Eco-Industrial Park** Londonderry, New Hampshire  
EID features include: EID codes & covenants; advanced combined-cycle gas power plant; natural/organic yogurt producer; open space preservation; integrated trail system; and power plant uses City's treated wastewater for cooling.



**Chicago Center for Sustainable Technology**, Chicago, Illinois  
EID features include: sustainable design; major brownfields remediation and redevelopment; building reuse; building integrated photovoltaic system; and the first U.S. "brightfields" pilot.



**Devens Planned Community**, Devens, MA  
EID features include: brownfields clean-up and redevelopment; third party facilitation of inter-business networking; EcoStar environmental management program provides incentives for improvement; and green certified golf course.

**DEADLINE DATE FOR SUBMISSION OF ARTICLES FOR NEXT ENRE NEWSLETTER**  
**April 15, 2004.** To submit articles, email articles as attachments in Microsoft Word compatible format or Rich Text Format to [tyfrazier@comcast.net](mailto:tyfrazier@comcast.net)

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