# Cuyahoga Valley Initiative

## A Model of Regeneration

Cuyahoga Valley
Respect Rediscover Revitalize

A report by
Rocky Mountain Institute

**Acknowledgements**

This report would not have been possible without the generous support and able assistance from the following organizations:


### Cuyahoga County Planning Commission

**http://planning.co.cuyahoga.oh.us**

The Cuyahoga County Planning Commission (CPC) performs a unique role in the Cuyahoga County community.

As a successor to the Cuyahoga County Regional Planning Commission (RPC), the CPC has over a half century legacy of providing land use, zoning, development, and other planning services for the county's cities, villages, and townships; the Board of County Commissioners; and other governmental and not-for-profit organizations.

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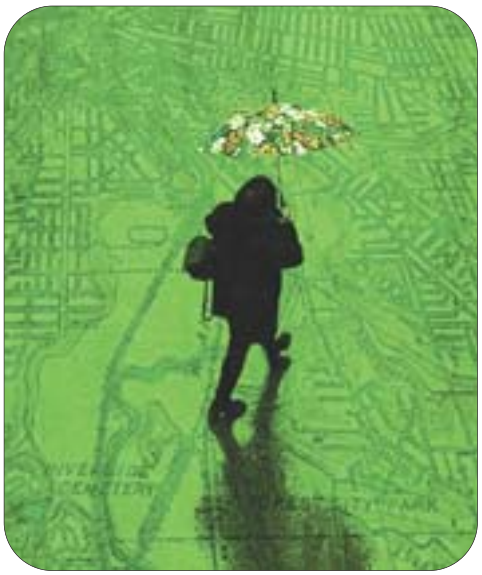
Rocky Mountain Institute is an entrepreneurial nonprofit organization that fosters the efficient and restorative use of natural, human and other capital to make the world more secure, just, prosperous, and life sustaining.

We do this by inspiring business, civil society, and government to design integrative solutions that create true wealth.



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**A report to the**

**Cuyahoga County Planning Commission**

**by**

**Rocky Mountain Institute**

**Supported by**

**The Joyce Foundation**

**and**

**The Gund Foundation**

*April 2004*

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*Contributions were made by Michael Kinsley, Will Clift, Jenifer Seal, Catherine Greener, Robert Wilkinson Ramola Yardi, and Holly Harlan.*

*RMI's Cameron Burns edited the report; Ben Emerson did the graphic design; and Bill Simon prepared and posted the document on RMI's website. Stephen Manka, of the Urban Design Center at Kent State University, did the drawings and digital montages. Photographs are courtesy the Cuyahoga County Planning Commission.*

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# Table of Contents

# Introduction

**In 2003 and 2004, a team from Rocky Mountain Institute worked with the Cuyahoga County Planning Commission and its circle of advisors to develop recommendations for regeneration of the environment, economy, and community of the Cuyahoga River Valley. Rocky Mountain Institute's (RMI) methodology for such tasks is whole-system integration of the activities, products, waste streams, commercial activities, and industrial and manufacturing processes of the people, businesses, institutions, and industries located in the Valley.**

**This report is succinct by design. Its introduction summarizes RMI's recommendations, then describes integrated solutions and how to build community capacity to put the Cuyahoga Valley vision to work. Each following section briefly describes a recommendation or set of recommendations, then outlines benefits, reasons the ideas will work in Cuyahoga County, barriers to implementation, and steps to overcome the barriers. Readers who require more information may refer to several appendices.**

# The Vision

### *From the Burning River to a Model for Regenerative Development*

**The goal of the Cuyahoga Valley Initiative (CVI) is to "revitalize the Valley and make it once again an economic force, environmental treasure, and unifying element for the region." Cuyahoga County Planning Commission's (CPC) mission is to provide the tools necessary to achieve this vision. Those tools will include programs, codes, guidelines, and incentives.**

**RMI believes the "burning river" that precipitated the Clean Water Act in the 1970s can lead the way toward regeneration of ecological, social, and economic systems, and sustainable management in the twenty-first century. The recommendations offered in this report are specific expressions of the Valley vision. They are the basis upon which programs, codes, guidelines, and incentives can be developed by local government, private businesses, and nonprofit organizations to move the Valley toward a sustainable future.**

# Restoration, Regeneration, and Value

***Integrated solutions find value even where none seemed evident.***

**Restoration of a gritty old industrial area will require many millions of dollars, normally a significant burden for any city. But regeneration is different from, and better than, restoration. It's a whole-system approach that, in addition to restoring the environment, rebuilds value in the economy and the community. Whole-system thinking—in which all parts of a system, including the entire system's external influences, are considered in unison—transforms many problems into opportunities and creates value even where none seemed evident. This can pay back many of the costs of restoration by increasing land value, generating revenues, and creating jobs in all three sectors: private, public, and nonprofit.**

**Certainly regeneration requires investment, but when done correctly and carefully it has the capacity to generate substantial revenues—dollars that will emerge from the Cuyahoga Valley's "next industrial revolution."**
(See p. 1A Appendix)

# Recommendations — A Summary

**Based on their on-the-ground research and interviews with Cleveland-area experts, the authors present the following recommendations as potential and practical ways to transform the Cuyahoga Valley into a model of economic, environmental, and societal sustainability:**

1. One portion of the Valley could be selected as a **Regenerative Development Zone**, marking it for special attention so that it serves as a model for the entire Valley's regeneration. It could be a laboratory for fresh ways of doing business—returning lost value to the land. It might receive and create exceptional incentives and programs that demonstrate harmony between industry and nature, consolidate industrial facilities, return buried watercourses to the earth's surface, test ways for businesses to share resources, create new pollution–mitigation and industrial clean-up businesses, and demonstrate clean energy and ecological restoration.

***Industrial Symbiosis creates more wealth regardless of future industrial expansion.***

2. **Industrial Symbiosis** is an innovative form of industrial collaboration that redefines waste and by-products as inputs to other industrial operations. It "engages traditionally separate industries in a collective approach to competitive advantage involving physical exchange of materials, energy, and/or by-products."[1] It offers development opportunities in the Valley regardless of prospects for future industrial expansion, creating more wealth within the existing mix of industries.

3. **Healing Cuyahoga Watercourses:** The river that has been a national symbol of pollution can be a model of restoration when the community helps it and its local tributaries reestablish their natural biological capacity to repair and sustain themselves. To achieve that natural capacity requires human intervention and the restoration of aquatic life and the natural flow of watercourses. It also requires stabilizing stream and riverbanks using permeable bulkheads and riverbank vegetation that will treat many urban pollutants while reducing sedimentation.

[1] Marion Chertow (Director of Yale's Industrial Environmental Management Program), *Industrial Symbiosis: Literature and Taxonomy*, Annu. Rev. Energy Environ.2000 25:313-37

4. **Green Buildings** are more affordable, comfortable, and livable for occupants, and can be more profitable for investors and owners than typical buildings. This creative development practice is superior to conventional design because it seeks to integrate each building into a larger system. Like many whole-system solutions, green buildings integrate multiple goals: financial success, resource efficiency, environmental sensitivity, and human well-being.

5. **Using Water Wisely:** Better and cheaper water service can be provided by improving the efficiency and effectiveness of the water and wastewater infrastructure, and by using rebates, incentives, and educational programs that encourage consumers to use water wisely. Also, such technologies as efficient toilets, washing machines, and spray nozzles can help reduce water demand while, in many cases, providing the same water services at lower cost. These efficiencies save even more money by not requiring as much energy as would have typically been required to pump, treat, and distribute wasted water.

6. **Storm Water as an Asset:** Because rainwater is directed into combined sewer systems, rainfall can be an indirect cause of significant water pollution. Heavy rainfall exceeds system capacity, forcing urban runoff and sewage into the river and the lake. To eliminate this pollution and save money on infrastructure, urban landscapes can be retrofitted and redesigned to absorb water into the soil where it falls, which in turn recharges groundwater and nourishes biological systems.

7. **An Energy Investment Strategy** that included an innovative and forward-looking mix of energy resources—notably renewable energy sources and energy efficiency—in the Cuyahoga Valley and the surrounding region would lead to greater energy security, lower consumer costs, less air pollution, local job creation, more reliable power, increases in the local economic multiplier effect,[2] and economic development.

8. **Energy Cogeneration Network:** Due to its high concentration of industrial facilities, the Cuyahoga Valley offers an unusual opportunity to realize the benefits of capturing and using waste heat from the generation of electricity, which saves money and reduces pollution by using fossil fuels more efficiently.

[2] "Multiplier effect" refers to the circulation of money within an economy. When a community keeps more money at home, the money recirculates, increasing the local multiplier. Each extra time a dollar changes hands before it leaves the community, it creates more value, pays more wages, finances more investments, and creates more local economic development opportunity.

# Recommendations (continued)

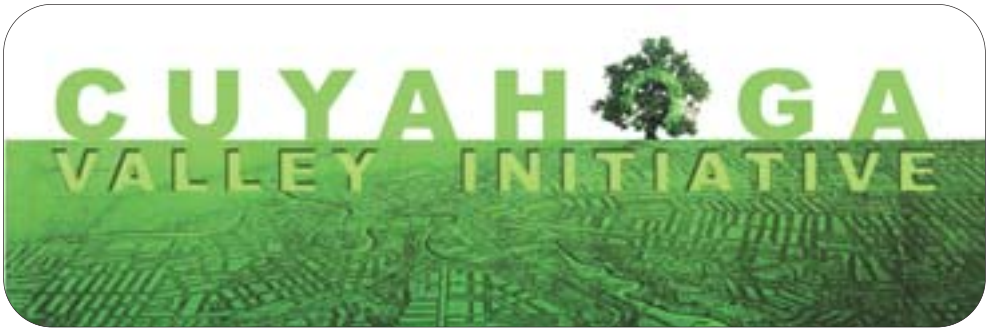
9. **Waste to Energy:** Two processes for converting wastes into energy show promise in the Cuyahoga Valley: methane-gas capture at landfills and the gasification of industrial, medical, and municipal wastes. These processes transform problems—pollution and storage—into economic value and jobs.

10. **Wind Turbines** harness currents of air to create renewable, zero-emission electricity—the development of which may also create local jobs and even new businesses in Cuyahoga County. Offshore areas of Lake Erie and various parts of the lake's edge offer locations where wind turbines can generate electricity at prices competitive with fossil fuel-fired power plants.

These recommendations are presented in no particular order.

Subsequent sections of this report describe each of these opportunities in more detail including:

- **Benefits** to the community, its economy, and the environment;
- An explanation of **why each idea will work** in the Cuyahoga Valley;
- **Barriers**;
- **Implementation strategies** (overcoming the barriers); and
- **Next steps**.



## Legacy and Opportunity

Cities around the world face challenges similar to Cleveland's: water and soil pollution, energy and resource constraints (especially clean water), and economic dislocation. Demonstrating integrated ways to overcome these challenges, and selling the concepts, services, products, and forms of social and economic organization needed to do so, can provide another form of development. Cleveland could become an international standard for regenerating industrial brownfields.

The Valley has shown in the past that industries can coordinate activities and cooperate for mutual benefit. An expanded version of this important legacy would become an example for other, similarly degraded, valleys. It could demonstrate success by documenting increases in various forms of value—economic, environmental, and social—resulting from such initiatives as those described here. The Valley could become a destination—a living laboratory, so to speak—for those who seek to learn how to emulate Cleveland in restoration and sustainable management.

For background on the Cuyahoga Valley, explore www.cuyahogavalley.net and www.ecocitycleveland.org/pdf_files

## Integrated Solutions:

### *Practical Ways to Confront the Cuyahoga Challenge*

The challenges that confront America's cities are daunting. The list is long and need not be repeated here, but one thing is clear: we need far better ways to confront our cities' problems. Working ever harder with conventional tools doesn't generate the results communities desire and often leads to gross inequities between those receiving community benefits and those paying for them.

Americans do not hesitate to confront their problems. Unfortunately, however, we tend to break them down into their constituent parts and single-mindedly push toward our chosen goal. Though this approach reveals our considerable dedication to and ability for problem solving, it also reveals a major weakness: focusing on individual problems in isolation.

Take, for example, this hypothetical situation: most of our cities have insufficient affordable housing. The usual response is to appoint a committee, open an agency, or start a nonprofit organization to build housing as inexpensively as possible. Since the goal is affordability, the objective—the sole objective—becomes low capital costs. That goal then becomes a search for inex-

**1**


pensive land, design, materials, infrastructure, and construction costs to ensure lowest possible capital costs.

What could be a nobler quest? It was the quest of Isles, a nonprofit housing-development organization in Trenton, New Jersey. And they did it well. They built lots of affordable units and housed hundreds of low-income residents.

***Integrated solutions generate multiple benefits that offer an even greater return on upfront cost.***

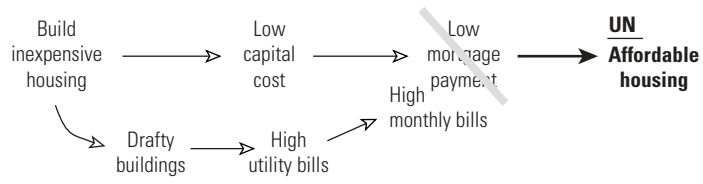
However, Isles CEO Marty Johnson (an Ohio native) was not convinced that his organization's methods for developing affordable housing were as refined as they should have been. He looked deeper. He sought feedback. He noticed what happened to the families that moved in to inexpensively built housing—their utility bills we so high and unpredictable that, combined with their mortgages, monthly expenses were often out of reach.

Another group might have had the attitude that high heating and cooling bills were not their problem. They might see their job as building inexpensive housing, period. In effect, this hypothetical, though typical, group would contend that energy consumption is not within the "box" it had defined for itself when it dissected the problems of low-income people and chose housing as its focus. The group (and its financial backers) probably would not have examined the larger system to understand, for example, that buildings with adequate insulation and advanced windows leak much less heat in the winter and remain cool in the summer—saving tremendous amounts of energy. Unfortunately, even when a developer does know that, most assume such measures are too expensive for low-income residents.

But the folks at Isles are system thinkers. They look at the big picture, at the long-term, at inter-relationships—no matter how myriad and complex—between many different factors. They refuse to confine themselves to some artificial box; they seek integrated solutions.

Isles officials' said to themselves, "Wait a minute, our job is not to keep the first cost of the house low,

**2**



it's to keep monthly payments low. Also, we know that the capital costs of aggressive energy-efficiency measures, carried in a mortgage, are far less than the monthly savings they achieve. And as a bonus, we can help clean the air by reducing demand on the local coal fired power plant."

Isles and CEO Johnson have discovered an important system-thinking paradigm: when the answer to a question leads to counterproductive answer, consider a different question. The Isles mission "to develop affordable housing," however commendable, had resulted in the wrong question (how to keep upfront costs low) being posed, ultimately leading to high monthly energy bills. So, Isles changed its mission statement to: "foster more self-reliant families in healthy, sustainable communities."

Isles not only started thinking systemically, the group institutionalized system-thinking. In addition to changing its mission statement, the group developed a set of indicators to keep it focused on genuinely productive outcomes and to clearly indicate real and substantial savings, regardless of internal accounting schedules. (For more on indicators, see "Measuring Progress" p.13.)

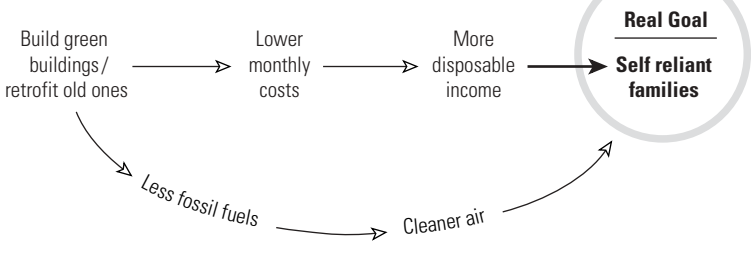
Though seemingly counter-intuitive, increased capital costs for energy efficient technologies and techniques are now reducing monthly housing bills in Trenton and many other places.[3] Energy efficiency in particular, and resource efficiency in general, are excellent examples of integrated solutions discovered through system thinking.

Like many integrated solutions, energy efficiency often addresses multiple problems, even some that weren't regarded as problems. For example, when the municipal electric utility in Sacramento invested $59 million to save electricity, instead of investing in a new power plant, it enabled its customers to save nearly that same amount. As a side effect, the investment created jobs for 880 local people installing efficiency devices and enacting efficiency measures (instead of employing many fewer non-residents building the power plant far from the community). Sacramento had increased the local multiplier effect and plugged big leaks in the local economy.

System thinking is challenging. Most technical experts are taught to focus on one specialty, and most political rhetoric is narrowly focused. That's why those seeking system solutions stress the value of

[3] State-of-the-art design, now incorporated into a wide variety of buildings, is so efficient that heating and cooling systems can often be omitted from construction without loss of comfort. The additional cost of the efficiency measures is often less than the savings achieved through elimination of the mechanical systems. Therefore, advanced building design can reduce both operating and capital costs.

**3**



***System Thinking:***

- ***Examine inter-relationships***
- ***Think long-term***
- ***Pursue multiple benefits***
- ***Seek feedback***
- ***Find the right indicators***
- ***Ask the right question***

collaboration among people with widely different skills and experiences. Integrated solutions are seldom found by an individual working alone; instead, they require many different kinds of people putting their heads together.

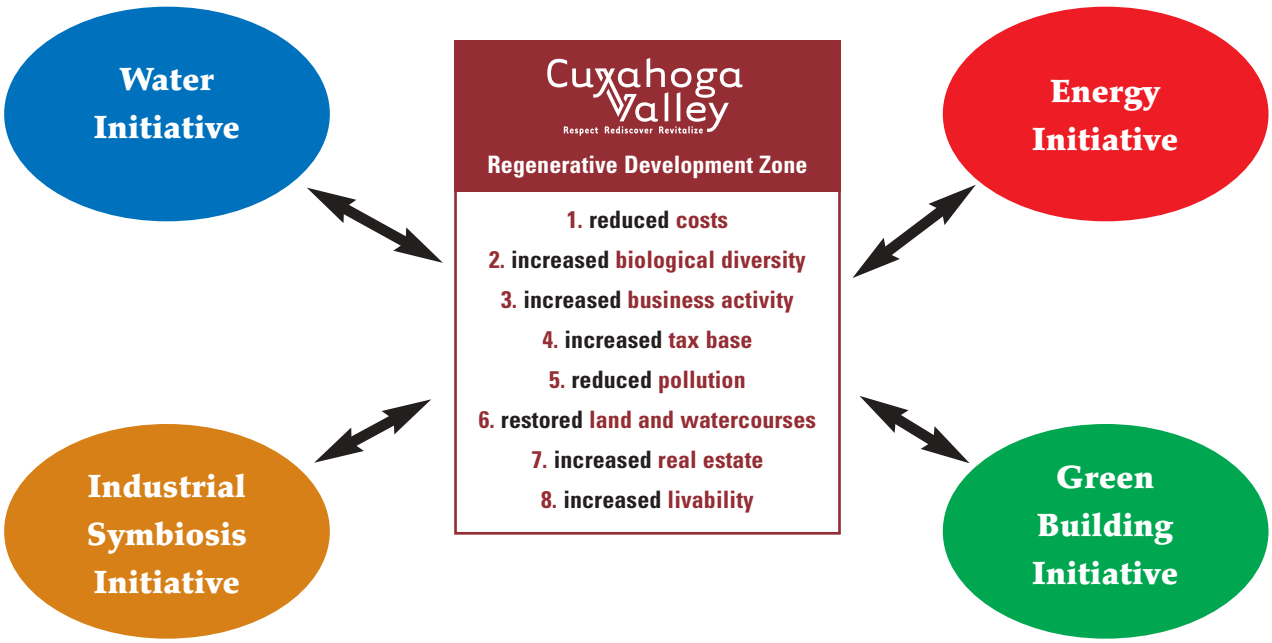
Fortunately, system thinking is precisely what's happening in Cuyahoga County. The Planning Commission has initiated a multi-year, collaborative process — The Cuyahoga Valley Initiative (CVI)— to transform Cuyahoga River Valley from blight to beauty; to reinvent the Valley with shared commercial, recreational, and natural assets.

From the beginning, this visionary effort has drawn on the considerable strengths of the private sector, government at all levels, and local nonprofit organizations.
It has convened people with different ideas, skills, and experiences to find integrated solutions.

Listed at the end of this introduction are many of the people who have been working with Cuyahoga County Planning Commission and Rocky Mountain Institute thinking systemically about the Cuyahoga Valley.

**Magnified Benefits**

Each recommendation in this report yields genuine benefits. However, when the various projects and programs are woven together, total benefits are magnified to create a healthy, vibrant, thriving community. The whole is, in fact, greater than the sum of the parts. In later sections of this report, more detailed diagrams will illustrate relationships and effects specific to energy, water, green building and industrial symbiosis initiatives. The last page of the report includes a final, more detailed version of the above diagram.



# Putting the Vision to Work — Building Community Capacity

## Champions

The Cuyahoga Valley Initiative requires action on many fronts—many projects and programs. To succeed, each must have a champion, an organization or individual committed to achieving the goal of the project or program. CVI supporters must become and recruit champions.

Although essential, the idea of project champions is not new. What is new is that the very nature of the Cuyahoga Valley Initiative—integrated solutions—requires that each champion think systemically, outside the boundaries of their project, program, or organization; and that they seek multiple solutions, multiple benefits, and ways each individual project can be designed to serve or be served by other CVI projects.

CVI will not succeed if each champion proceeds in heroic isolation. That may be the path to individual success, but it's also the path to community failure. Regeneration of the Cuyahoga Valley requires a new breed of champion: collaborative advocates committed to community success, not focused on personal victory. The champions must be part of, even beholden to, a much larger team or organization whose mission is the overall success of the Cuyahoga Valley Initiative.

## Organization

Successful regeneration of the Valley requires that a lead organization oversee, coordinate, and drive the process. The organization could play many roles. This report's authors suggest it:

- Coordinate the overall implementation of CVI, including the recommendations in this report;
- Develop criteria for prioritization of potential projects and programs based on the Valley vision and eventually based on indicators of regeneration. (See "Measuring Progress" p. 13.) Similar criteria could be used to determine the compatibility of future development ideas;
- Prioritize the various recommended and proposed projects;
- Convene project and program champions periodically;
- Explore ways to capture (and share) the value of appreciating public assets;
- Constitute or create a redevelopment organization that leads the Regenerative Development Zone; (see p. 19)
- Organize and advocate an industrial symbiosis program (see p. 27); and
- Develop indicators of regeneration;

## Organization (continued)

- Reach out to (seek the participation of) champions who may adopt and proceed with some regeneration projects independent of this organization;
- Work with local universities to measure and track increasing economic, environmental, and social value generated by the CVI effort; and
- Market CVI and regeneration to the community.

The organization could also:

- Develop alternative scenarios for the Valley, which could position the community to respond rapidly and constructively to changes imposed on local industry by external economic forces; and
- Sponsor system-thinking seminars for champions, board members, and citizens.

Some have suggested that the Cuyahoga County Planning Commission should lead CVI. This suggestion is a tribute to the visionaries who govern and staff the Commission. However, CVI cannot succeed if driven by the public sector alone.

To be fully owned by the private, public, and nonprofit sectors, as well as all community factions and interests, and to mobilize the talent needed to understand, design, and manage the complexity of the Cuyahoga Valley Initiative, the authors recommend that the driving force be a nonprofit organization governed by people from a wide array of local interests and with varied skills. Such an organization may be new or an adaptation of an existing group.

Selection of the board of directors of this organization may be the single most important step in the CVI process. The selection procedure is both simple and crucial, and should include the following three steps:

1. List every group and faction that is likely to be interested in what happens in the Cuyahoga Valley, including the private, public, and nonprofit sectors;
2. Identify two or three people from each group who are thoughtful, respected by the group, and who can see the bigger picture—not fiery advocates, but thoughtful "elders." (Elders are wise but not necessarily old.)

   *A key point: directors of the nonprofit must not be formal "representatives" of any particular group. Representatives are often hamstrung—obligated to bring only their group's inflexible position to the table, often to the exclusion of other points of view. In sharp contrast, elders come to the table with their groups' underlying interests and ideas. Representatives tend to argue, while elders discuss.*

   Some of the directors may also be champions.

3. Recruit one of those two or three people to serve on the board of directors. Hopefully several groups will respect many of these individuals so that the number of board members is smaller than the number of groups.

When people from all relevant factions and interest groups feel comfortable that at least one director will articulate their interests, the right balance will have been achieved.

The board may be quite large, with possibly thirty or forty members, which is too large for day-to-day governance. Everyday governance should be the responsibility of a much smaller, elected executive committee.

Each board member should commit to:

- System-thinking and integrated solutions that benefit the community, its economy, and environment; and
- Fully communicating the activities of the organization to his or her constituents and vice versa. Feedback is essential to system thinking and long-term success.

The nonprofit should have a professional staff. CVI will succeed when smart people are employed to bring its ideas to fruition, which will include managing the process, coordinating volunteers, and finding financing.

Each local government should assign one person to support the nonprofit and lead regeneration in each of the twelve local governments. This dozen or so should meet regularly.

## Measuring Progress — *"Indicators of Regeneration"*

Every community uses indicators. Typically indicators are such measures as sales tax revenues, housing starts, and industry trends. Though useful, these conventional measures offer only a partial picture of what occurs in a community. Worse, community leaders often focus their efforts on these indicators because they're regularly measured, regardless of whether they're genuinely important to the community. Moreover, in isolation these narrow indicators often paint a false or incomplete picture, indicating that the community is better or worse off than it really is.

Compare community indicators with the "indicators" on the dashboards of our cars. If we could see only read-outs for tire air-pressure and passenger-compartment air-quality, for example, they wouldn't help us avoid running out of gas. In our communities, we often monitor property values for example, but those numbers may not help us avert a crisis in housing affordability. Often we have a far clearer picture of the operation of our cars than the progress of our communities.

***When carried out, many of the recommendations in this report will generate real costs that will be easily measured, reported by the press, and understood by the public. Also, they will generate significant and substantial value, the measurement of which is less straightforward. When that value is clearly measured and understood, money to sustain the regeneration effort will follow.***

In order for a community to measure genuine progress, it must first decide what's important, which is usually a mix of factors that relate to community values (e.g., newborn weight), environmental conditions (e.g., water quality), and economic indicators. However, in general the community must probe the economy more deeply (e.g., housing affordability), examining more than conventional measures.

In order for the Cuyahoga community to understand its progress toward the Valley vision, a program should be initiated to develop Cuyahoga indicators and bundle them so that, for example, local leaders can better understand the real value of CVI and better know where to focus limited resources.

Based on a fully developed Valley vision, the indicators might include jobs, land values, land assembly, multiplier effects, water quality, public use of new green space, volume of waste recycled, energy intensity, miles of trails built, acres of wetlands restored, miles of streams daylighted, and even picnickers on Sunday afternoons. But these are only examples; the community must say what it wants and develop its own indicators accordingly.

## Technical Capacity

Implementation of some elements of CVI will require objective information, hard science, and creative design. These resources may be forthcoming from several local academic institutions, or they might be housed in a new institution, possibly a Cuyahoga Institute, with which local academic institutions may wish to partner.

This institute could play many possible roles, for example:

- Research and development;
- Incubation of new businesses;
- A testing ground for regenerative land and water research, and possibly a center for regenerative studies;
- An enterprise network of private businesses; and
- A training academy for innovative restoration and sustainable management practices.

Here are some of the people who have been working with Cuyahoga County Planning Commission and Rocky Mountain Institute thinking systemically about the Cuyahoga Valley:

| | |
|---|---|
| Becky McCleary | City of Cuyahoga Falls |
| Betsy Yingling | Northeast Ohio Regional Sewer District |
| Bill Zawiski | Ohio EPA |
| Brad Masi | Northeast Ohio Food Alliance |
| Brian Schneiderman | Shorebank Enterprise Group |
| Claire Posius | City of Cleveland Planning Commission |
| Connie Perotti | Maingate BDC |
| Dave Humphrey | Cuyahoga Valley National Park |
| David Beach | EcoCity Cleveland |
| David Goss | Greater Cleveland Growth Association |
| Dennis Mersky | EDG |
| Diane Koslowski | U.S. Army Corps, Buffalo District |
| Eric Lofquist | General Environmental Management |
| George Cantor | City of Cleveland Planning Commission |
| Grant Marquit | Enterprise Development, Inc./Jumpstart Inc. |
| Herb Crowther | CAP |
| Howard Katz | Cuyahoga County Treasurer's Office |
| Hugh Shannon | County Commissioner Peter Lawson Jones |
| Jackie Nameth | Clean Air Conservancy |
| James Hiendlmayor | Bio-Gas Tech |
| Jay Myers | City of Cuyahoga Falls |
| Jennifer McMahon | Cuyahoga Valley National Park |
| Jim Kastelic | Cleveland Metroparks |
| Jim Krimmel | Zaclon, Inc. |
| Jim Pressler | Flats Oxbow CDC |
| Jim White | Cuyahoga River Remedial Action Plan |
| Joe Pustai | eQuest |
| Joe Turgeon | Zaclon, Inc. |
| Kareemah Williams | CIRI |
| Kari Moore | Northeast Ohio Foodshed Network |
| Kate Grimberg | Student |
| Katrina Fritz | Case Advanced Power Institute |
| Ken Pasterak | Multi-Lynx |
| Linda Robson | CWRU Dept. of Organizational Behavior |
| Lisa Hong | eQuest |
| Mark Conti | US EPA |
| Marlane Weislan | Slavic Village CDC |
| Patty Stevens | Cleveland Metroparks |
| Sadhu Johnston | Cleveland Green Building Coalition |
| Sally Parker | Currere |
| Scott Theal | Multi -Lynx |
| Steve Litt | Cleveland Plain Dealer |
| Tim Donovan | Ohio Canal Corridor Coalition |
| Tom Zawodzinski | Case Advanced Power Institute |

And this is just the beginning

## Rocky Mountain Institute

RMI is an entrepreneurial nonprofit organization that fosters the efficient and restorative use of natural, human and other capital to make the world more secure, just, prosperous, and life sustaining. It does this by inspiring business, civil society, and government to design integrative solutions that create true wealth. Its staff helps businesses, communities, individuals, and governments create more wealth and employment, protect and enhance natural and human capital, increase profit and competitive advantage, and enjoy many other benefits—largely by doing what they do far more efficiently. Its work is independent, nonadversarial, and transideological, with a strong emphasis on market-based solutions.

### RMI Involvement in CVI

**Exploratory workshop — April 23–24, 2003**

RMI conducted the session, with approximately 50 participants from private, public, and nonprofit sectors who were introduced to Valley details, system thinking, and the economic, environmental, and social aspects of the project. They then identified assets and problems on the test site, explored linkages among those characteristics, identified changes that could regenerate the site, and explored guidelines, practices, and incentives that might result in those changes.

**Site visit — January 15-16, 2004**

RMI returned to the Valley with more of its experts, examined one portion in particular, met with dozens of local experts from many fields, and developed preliminary findings.

**Innovation workshop — February 9-10, 2004**

RMI's presented its preliminary ideas to local experts; heard their thoughts on what should be added, subtracted and changed; then developed this report including those responses.

## RMI Team

Michael Kinsley, Project manager, RMI Community Services

Will Clift, RMI Energy Services

Catherine Greener, RMI Commercial & Industrial Services

Holly Harlan, Entrepreneurs for Sustainability, Cleveland

Steve Manka, Urban Design Center, Kent State

Jenifer Seal, RMI Green Development Services

Joel Swisher, RMI Energy & Resources Services

Sara Weiss, RMI Commercial & Industrial Services

Robert Wilkinson, University of California at Santa Barbara

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# Regenerative Development Zone

**The authors of this report recommend that the centerpiece of the Cuyahoga Valley Initiative be a "Regenerative Development Zone" that serves as a model for Cuyahoga Valley regeneration and a laboratory for fresh ways of doing business.**

**The Zone would include creative codes, guidelines, incentives, and programs that:**

- Test innovative ways for industries to share resources—ways that reduce waste and emissions, and promote ecological health;
- Foster business and create new jobs in, for example, industrial clean-up and environment technologies;
- Demonstrate clean-energy production and ecological restoration techniques for land and water;
- Implement natural storm water management strategies;
- Restore natural vegetation, for example, under highway overpasses;
- Use non-toxic, energy-efficient biological-wastewater-treatment systems;
- Establish new opportunities for revenue-generating restorative enterprise and industrial tourism;
- Design new buildings and renovate old ones using green development principles;
- Create scenic overlooks and educational material (signs, etc.) for a scenic byway and recreational tow-path;
- Include an "ecological theme park" using old industrial structures and promoting the idea of industrial tourism;
- Create a living laboratory for area universities and colleges, possibly via a "Cuyahoga Institute." It might provide an incubator for new businesses and a testing ground for regenerative land and water research; and
- Create a home for the proposed Cuyahoga Urban Land Conservancy.

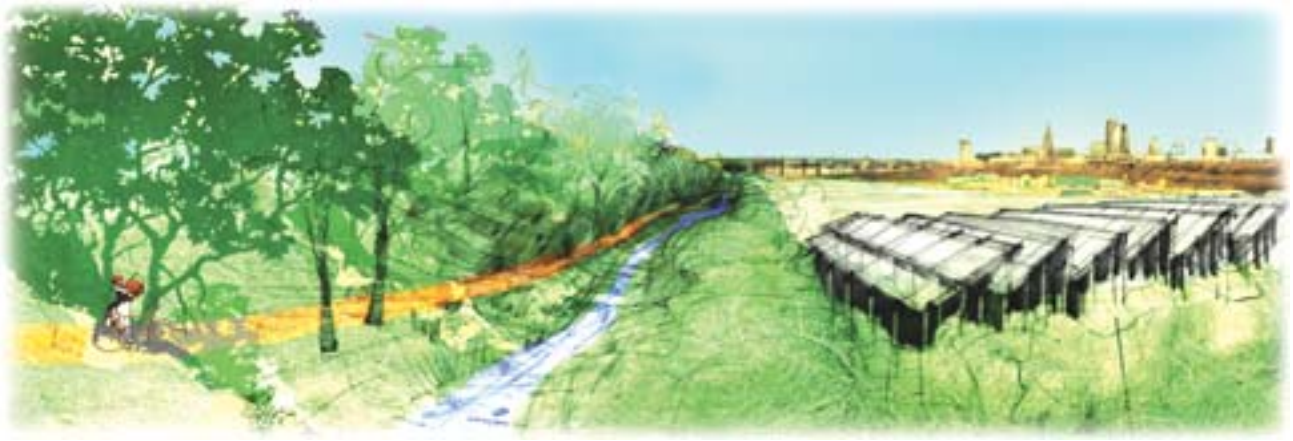
The CVI process is generating a wide range of action ideas, including those in this report. Though some of the ideas suggest community-wide and policy changes, most recommend projects that can be undertaken on particular sites in the Valley, such as the site that RMI examined most closely, the area around Maingate, ISG, Zaclon, and General Environmental Management. Implementing a package of mutually reinforcing ideas first on a single site would increase the potential for synergistic effects (i.e., benefits that are multiplied and increased by combining several actions). For example, restoration of a Cuyahoga tributary that is now culverted would provide surface water for revegetation of a building site, making the site more attractive for an office building. The office building might be heated with waste steam from a nearby industry. Its design could include features that capture storm water on the site further beautifying it.

If the Regenerative Development Zone were located within the Maingate Business Development Corporation, it could build on the business inter-connects developed by Maingate and the environmentally-creative work of such leading companies as General Environmental Management (GEM) and Zaclon. Zone incentives and programs could:

- Bring the now buried Kingsbury Run back to the surface, restoring its natural course and ecological integrity including wetlands (landscape architects call this "daylighting");
- Create greenways that connect the river with the Tremont and Slavic Village neighborhoods and businesses; and
- Consolidate Zaclon facilities, leaving roughly 26 acres available for redevelopment.

For information on examples of brownfield development, biological wastewater ecosystems, and Cuyahoga County's Greenspace Plan, see Appendix 2.

*Integrating industry and nature — daylighting tributaries*



## Benefits

When communities make degraded areas more attractive, people inhabit it them and use them. As areas of urban decay are transformed into neighborhood amenities, more people appear on the street. More people on the street reduces crime and the costs associated with crime (e.g., security expenses, loss of area retail revenues, real estate prices, etc.). Carefully redeveloping a neighborhood, suburb, or entire city yields tremendous benefits. In the case of the Cuyahoga Valley, it:

- Increases the attractiveness and value of property along the river edge;
- Helps build Cleveland's next economy;
- Creates a model for restoration of industrial sites;
- Reestablishes biodiversity by strengthening habitat communities, eradicating invasive exotic species (weeds), and reintroducing native species;
- Creates opportunities for new businesses, including such innovative businesses as aquaculture and a new farmer's market (possibly part of Maingate's Food Capital of Ohio);
- Demonstrates the artful integration of more ecologically-responsible solutions, for example, natural storm water systems;
- Provides learning opportunities for building green;
- Offers an attractive and interesting route for the recreational towpath and provides regenerative educational opportunities along the way;
- Employs modular biological wastewater treatment systems, which:
  - saves the expense of piping effluent to more remote locations;
  - reduces chemical inputs by treating wastewater naturally;
  - generates saleable "by-products" such as plants and fish; and
  - attracts tourists.

*Biological wastewater treatment*

- Promotes worker attraction and retention by providing an appealing work and living environment; and
- Creates access for neighborhoods to new parks and a restored river (e.g., Tremont and Slavic Village).

## Why this idea will work in the Cuyahoga Valley

- Cleveland's momentum toward and interest in innovation and sustainability is well underway (e.g., Eco-City Cleveland, Entrepreneurs for Sustainability, and the Cleveland Green Building Coalition);
- The City of Cleveland has a 15-year history of land banking;
- The County was instrumental in creating the U.S. EPA's Brownfield Program, making the community the cradle of the national brownfield redevelopment effort;

- Maingate Business Development Corporation has a 14-year track-record of successful business development and is strategically located at the intersection of a major transportation hub;
- Already, there are natural spots along the river where people picnic (e.g., near Maingate). They describe enjoying the river, the natural vegetation, and the wildlife;
- Biological wastewater treatment systems are being used successfully around the country for individual buildings and for municipalities, and have been used to restore Superfund and heavy-metal-contaminated sites;
- History of funding success (e.g., The Robert Wood Johnson Foundation awarded Slavic Village $14 million for brownfield redevelopment. Clean Ohio Bond Funds awarded $2.8 million to Cleveland for a 550,000-square-foot clean-up. The U.S. EPA Brownfield program would like to fund Cuyahoga brownfield cleanup and urban revitalization; and
- The recently formed Brownfield Coalition is comprised of representatives from the City, the County, and certain suburbs who have recently applied for $3 million from the U.S. EPA to work on projects.

## Barriers

There are many real and perceived barriers to redevelopment in the Cuyahoga Valley, including the following:

- Some residents suggest that the "mindset of local leadership" is a barrier;
- While the Valley's gritty character and messy vitality can be appealing, some residents note that smells in the Valley might be a barrier to redevelopment;
- Lack of readily available land. Certain industrial facilities are now inefficiently spread out on their sites;
- Buying out and relocating some businesses;
- Remediation programs and incentives for clean-up are currently lacking;
- Much of the current zoning in the Valley allows industry only;
- Some industries may perceive nearby public access to the river as a liability risk; and
- Securing financial partners to engage in the Zone.

[1] Several cities have experienced intense real estate speculation on river-front properties as they are cleaned up and redeveloped. (Both Miami and Chicago have experienced this intense speculation.) In some cases, preclusion of public access along the corridor creates discontinuities in the system and cities must pay great sums to get easements. The idea suggested here is to work with landowners in a partnership at the beginning of the process so that both the community and the landowner benefit. The Trust for Public Land works with communities on "greenprinting" efforts and in the process helps acquire key parcels to make the systems work.

## Implementation strategies

The authors recommend the following strategies for creating then managing the Regenerative Development Zone:

- Amend zoning codes to allow a mix of uses in the area. In addition to industry, allow limited recreational, office, and retail development. This zone could begin to change the risk perception of residents regarding river access;
- Include an "economic-development easement" in the Regenerative Development Zone, which would offer:
  - Increased property value;
  - Special tax benefits;
  - A new set of performance-based codes that promote the kind of regenerative activities described in this report;
- Develop incentives and programs to encourage experimentation with the concepts outlined here. Incentives will encourage pioneers to step forward;
- Guarantee long-term public access to public assets. As the Cuyahoga Valley Initiative becomes successful, real estate values will increase on private lands in the Valley and there will likely be attempts to close them off to the public. Using the Trust for Public Land's model, work with river-edge land owners to place a conservation easement along the river[1] in return for the benefits they receive from the Initiative;

## Implementation strategies (continued)

- Conduct a risk-based remediation plan. Start with U.S. EPA-funded Phase I Environmental Assessments for each property or across the entire area, which will identify specific environmental problems, if any. From this assessment, identify "quick-win" redevelopment options to demonstrate success;
- Utilize such tools as CommunityViz, a three-dimensional modeling and economic indicator tool, to aid community understanding and planning of the cumulative effects (positive and negative) of proposed development. Illustrate the regenerative opportunities and economic effects of decisions;
- Seek development partners (e.g., Forest City Enterprises) to engage in green-development initiatives;[2]
- Develop a revitalization plan for the river channel by working with the Army Corps of Engineers and ecological restoration experts such as Andropogon;
- Hold "ecological innovation strategy" meetings with such sustainability experts as Entrepreneurs for Sustainability and Maingate businesses;
- Plan this Zone to be compatible with Cuyahoga County's Greenspace Plan;
- Complete the tow-path to encourage residents to visit the Valley and notice opportunities for regeneration;
- Initiate a technical design-review support network to eventually spread valley wide. Comprised of members from such groups as Entrepreneurs for Sustainability, this network could be a sounding board and offer technical feedback as projects are proposed in the Zone;
- Develop beautiful and artistic natural storm water management structures by working with creative local designers (e.g., Ecocity Cleveland and Kent State's Urban Design Center).

[2] Forest City's Denver office is working on the redevelopment of the former Stapleton Airport as a mixed-use, green development project.

*Before and after: Photo of a Pittsburgh culvert outfall today (this page) and a drawing of how the culvert would appear if creatively designed (next page)*

- Establish a green-roof initiative for the Zone as part of the natural storm water management strategy. Green roofs:
  - cut the amount of storm water run-off by as much as half;
  - lower ambient air temperature by reducing the amount of heat re-radiating from the roof;

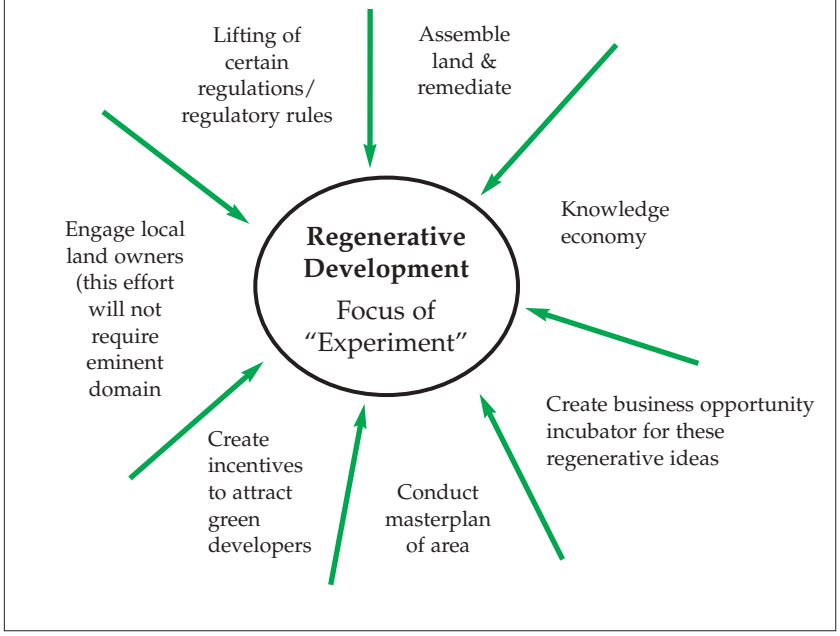
  - improve air quality by producing oxygen, absorbing carbon dioxide, and filtering the air;
  - provide native-species habitat;
  - conserve energy by increasing the roof's insulation value;
  - can extend the life of the roof many years; and they
  - are beautiful and improve livability.

- Support natural storm water retention methods in road projects;
- Develop incentives to encourage proper site development, management and maintenance;
- Coordinate the Regenerative Development Zone program with EcoCity Cleveland's Watershed Planning Partnerships and the Bioregional Plan for northeastern Ohio;
- Write the story of the regeneration of the Valley and distribute it locally, nationally, and internationally;
- Work with the Cleveland Green Building Coalition on its Green Building Code project and other municipalities developing green building guidelines. A revised code would require buildings to be more energy and resource efficient, non-toxic, and environmentally responsible; and
- Use this Regenerative Development Zone as a model for what could happen along the rest of the Valley corridor.

## Next steps

- Establish a nonprofit redevelopment organization to drive this concept and create an understanding of the long-term effects of conventional versus regenerative development;

**Cuyahoga Valley Redevelopment Entity.**




- Create the position of "Cuyahoga Regenerator" for every municipal jurisdiction. This regeneration coordinator would drive the concept within local government, develop an understanding of regeneration within local government, and work with local regeneration experts;
- Secure grants (e.g., Clean Ohio Bond Fund, EPA $400,000 fund for Phase I assessments, Robert Wood Johnson Foundation, etc.);
- Work with the AIG Global Real Estate Brownfield Program, which seeks equity investment in brownfield projects. AIG is looking to partner with a solid, seasoned local developer on pioneering projects (e.g., land purchase) before remediation has occurred;
- Engage Shorebank's brownfield redevelopment Environmental Knowledge Network in a "quick-win" project in the Regenerative Development Zone based on Phase I environmental assessment studies. EKN is a group of attorneys, developers, brownfield consultants, and brokers.
- Develop a "green loan fund" to support redevelopment ideas. The fund would provide moneys for small businesses for Phase I environmental assessment, attorney fees, etc. Also, consider as a model, Delta Institute's Great Lakes Redevelopment Initiative Fund, which provides $30 million in flexible financing for brownfield redevelopment.
- Encourage local community development corporations and others to attend the Delta Institute and Lincoln Institute of Land Policy community redevelopment brownfield seminar, a practical how-to session on financing, liability, risk avoidance, and environmental assessment in Detroit, in September 2004.

# Industrial Symbiosis

## Waste = Opportunity

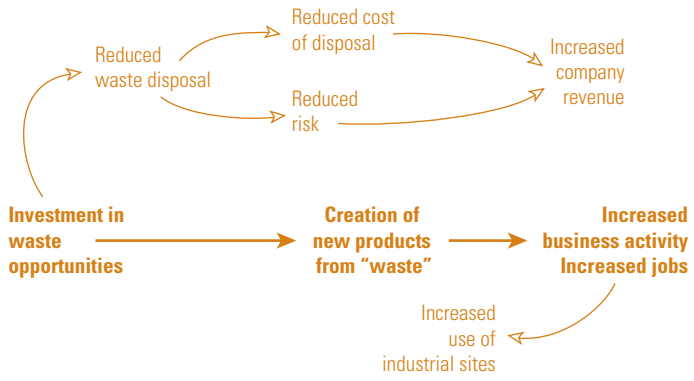
**The Cuyahoga Valley is famous for leading the early stages of the Industrial Revolution with such pioneering entrepreneurial ventures as Standard Oil, Grasselli Chemical, and a wide range of production activities that generated substantial wealth. Less known is that much of this success was built on industrial supply-chain collaboration. Unfortunately, these successes also generated a substantial amount of waste and other unintended consequences that the Valley and the surrounding communities are continuing to address today.**

**Fortunately, much of that waste, so long a problem, is now beginning to be considered an emerging opportunity. Taking root in the Cuyahoga Valley is a modern form of industrial collaboration that redefines waste and by-products as inputs to other industrial operations. It includes sharing utilities and resources, and creating local sources of energy to generate heat, steam and other inputs. It's often called "industrial symbiosis," after its biological counterpart, which is a close association of different species for mutual benefit. Appendix 3 includes three examples of industrial symbiosis in North America and one in Denmark. The Danish example answers many questions about this intriguing phenomenon.**

1

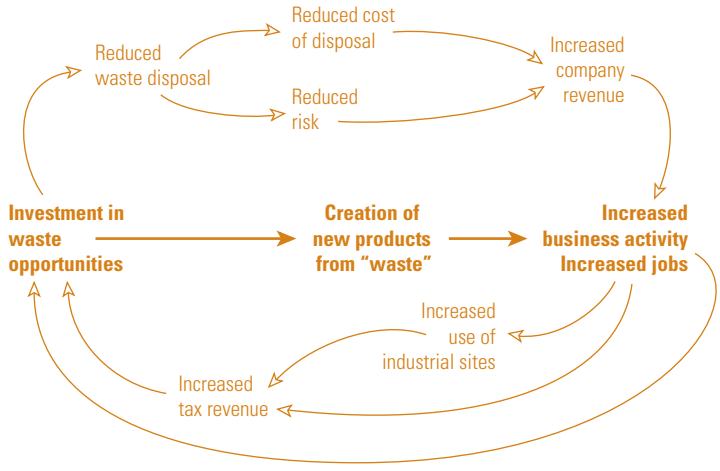

Investments in waste opportunities reduce waste disposal costs and risk, which frees up company revenue. Additionally, increased business activity may lead to increased use of old industrial sites.

2




Much freed-up company revenue will be re-invested. Increased business activity and jobs will increase tax revenue, which can be reinvested in discovering even more waste opportunities, reinforcing the industrial symbiosis cycle.

3




These diagrams only begin to illustrate the inter-relationships among many factors. They do not reflect full complexity or all opportunities.

*Industrial symbiosis creates more wealth within the existing mix of industries.*

**Viewing the Valley with this new industrial model in mind, a wide range of business opportunities come into focus. A factory now venting vast quantities of steam might pipe that steam to another industry that's paying for heat. A chemical manufacturer, now paying dearly to dispose of a certain toxic by-product, might pay less to another business that can create new products and new revenue streams. Appendix 4 is a preliminary inventory of industrial inputs and outputs in one portion of the Cuyahoga Valley.**

**Pursued aggressively, this innovative model of industrial matchmaking offers many business opportunities in the Valley, regardless of prospects for future industrial expansion. Industrial symbiosis creates more wealth within the existing mix of industries. It's the foundation for the next industrial revolution.**

## Benefits

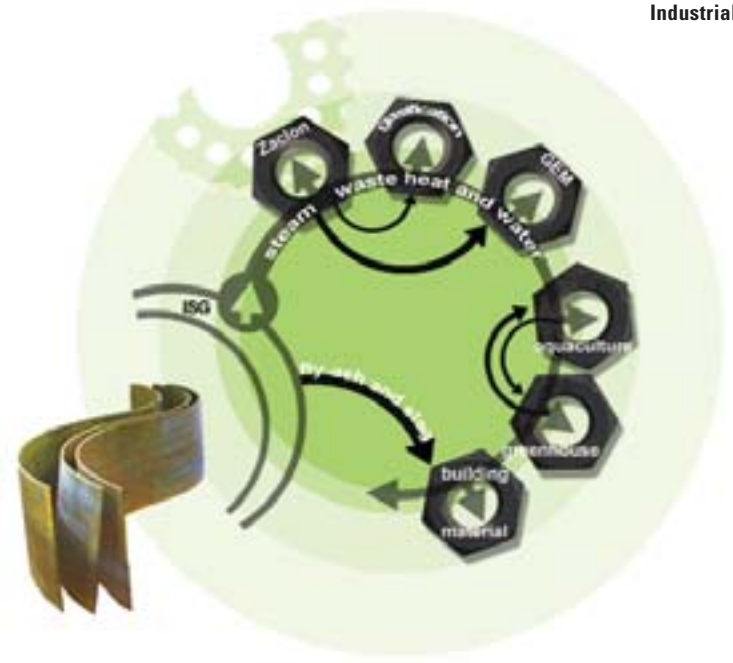
- Job and business creation;
- Improved competitiveness through reductions in operating costs in existing businesses;
- New design paradigm that can stimulate innovative product creation;
- The building of relationships between business leaders and their businesses thus improving business retention, resilience, and participation in the community;
- Accelerated use of existing industrial "brownfield" sites;
- Attraction of industries to the Valley that fit with current industry material flows;
- Elimination or reduction of risk from waste and by-product disposal;
- Reduction of dependence on, and use of, municipal services such as wastewater treatment and landfills;
- Source of heating and cooling for low-income housing; and
- A positive image.

### General Environmental Management

Located in the Cuyahoga Valley, General Environmental Management is already practicing industrial symbiosis. The successful firm uses chemical treatment, micro-fine filtration, and biological polishing to produce fuel oil, solvents, and inert residual solids by recycling such industrial wastes as fuels, solvents, paints, oily wastewater, and refinery wastes.

## Why this idea will work in the Cuyahoga Valley

- Various industrial symbiosis examples exist in other locations (e.g., Midlotheon Texas; Tampico, Mexico; Alberta and Montreal, Canada; and Kalundborg, Denmark);
- The valley's industrial heritage includes infrastructure that was established around industrial collaboration and the economics of sharing resources. There may be opportunities to revitalize physical resource sharing infrastructures (e.g., piping) that were installed during earlier operations;
- Regional clusters of economic development and clustering of like businesses make the area ripe for this approach;
- The Maingate Business Development Corporation has assembled a group of business leaders focused on revitalization through economic collaboration; and
- Entrepreneurs for Sustainability is matching emerging markets and needs, and seeking new business opportunities for the region.




## Barriers

- Lack of familiarity with the inputs and outputs of other enterprises;
- Little knowledge of whole-system product and process design, perpetuating the "take-make-waste" business model;
- Lack of relationships among business leaders, managers, and local economic development specialists;
- Initial investment may be needed to install or upgrade infrastructure in order to share utilities;
- Potential dependence of collaborating companies (i.e., one company could become dependent on the waste stream of another); and[1]
- Certain environmental regulations may not adequately account for the environmental value of industrial symbiosis.

[1] See "Managing the Risks of Interdependency" on p. A9 of the Appendix.

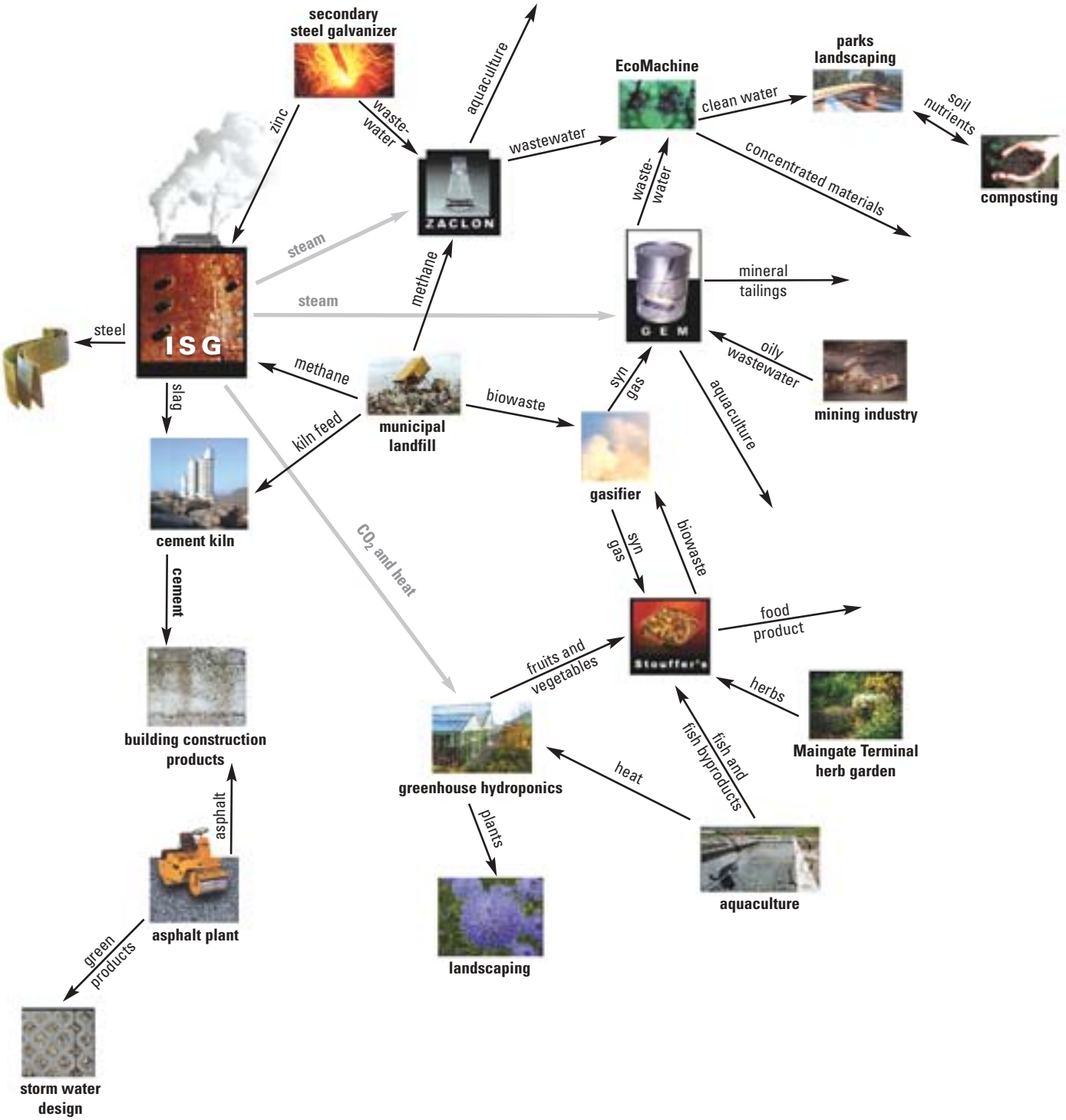
## Implementation strategies

- Create a trading market, possibly similar to bartering, for industrial symbiosis;
- Develop a collaborative dialog between business leaders, EPA representatives, economic development specialists, and other government representatives to review existing regulations and policies, understand potential barriers, and develop ways to overcome them;
- Identify capital investment resources to improve existing systems;
- Establish research relationships with academic institutions to develop alternative economic models for participating companies. This effort would include charting the practical effects on participating companies' balance sheets;
- Develop a marketing campaign to attract new ventures and operations; and
- Create a green-business standard, which could become a universal standard for industry, as did the U.S. Green Building Council's LEED standard for green buildings.

## Next steps

- Inventory and map resource, waste, and by-product flows, as well as rates of consumption and effluent for a wide range of Valley enterprises;
- Document local experiences and lessons, and tell success stories to encourage more participation;
- Generate awareness of industrial symbiosis and whole-system design among the Valley's business leaders;
- Build relationships among business leaders, managers, and economic development professionals who can take this idea to the next stage, which might be:
  - Enlisting a local nonprofit organization to fill the role of a Cleveland green business council. Such a council could, among other things:
    - Promote the idea of industrial symbiosis by, for example, establishing an appropriate mix of effective incentives and policies; and
    - Investigate industrial resource and output sharing ("waste-matching"), including specific suggestions for starting a business.

## Industrial Symbiosis in the Cuyahoga Valley (potential linkages)



*Baima Canal, essentially an open sewer for 12,000 people in Fuzhou, China. In 2002, Ocean Arks International (www.oceanarks.org) installed a bioremediation system that uses floating rafts of plants, microorganisms and aquatic life, combined with an aeration system. Drawing upon natural technologies found in ponds, marshes and streams, the system has dramatically improved canal water quality.*

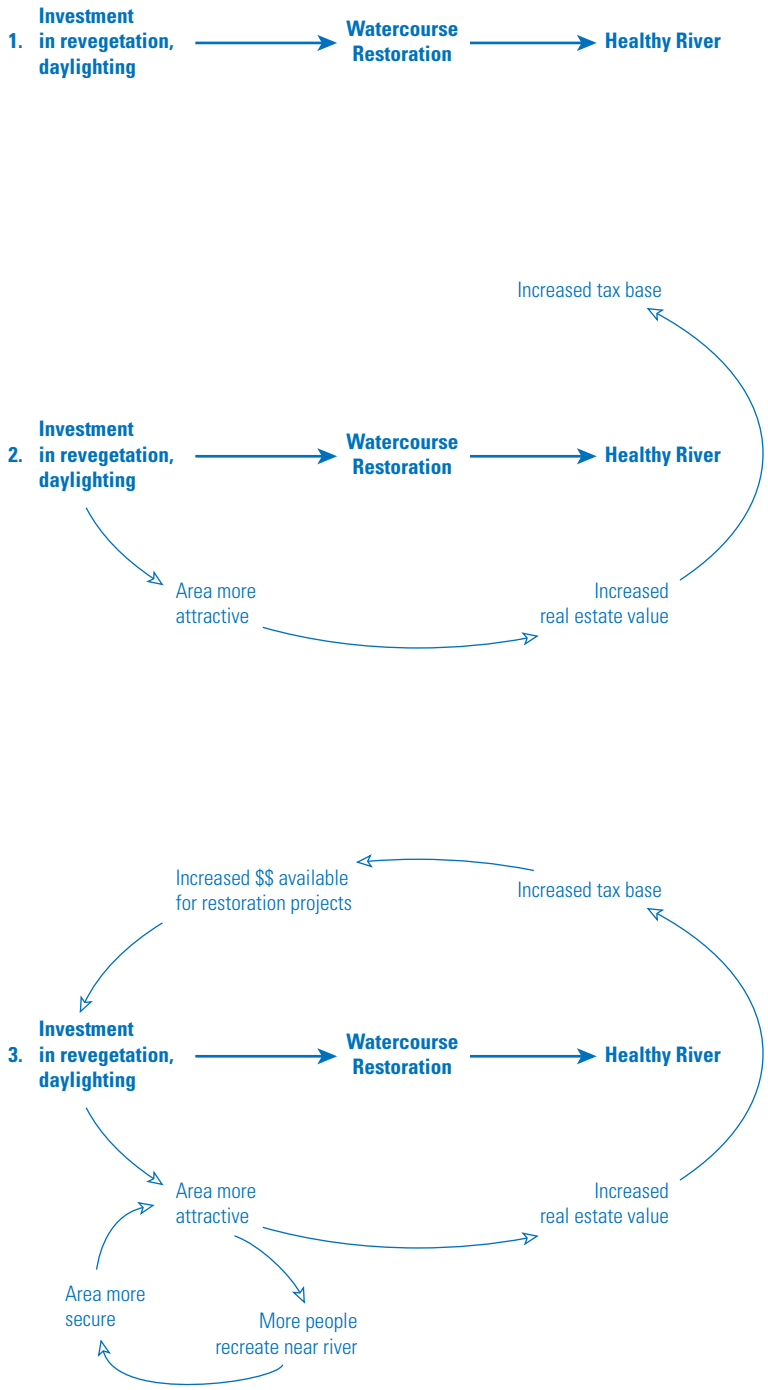
# Healing Cuyahoga Watercourses

Rivers have an extraordinary capacity to heal themselves. Given the right help, even those with bleak histories can make comebacks. The challenge facing such regions as Cuyahoga County is how to assist the river in this process. One way is to regard storm water as an asset (see p.53, Storm Water). Another is to develop a comprehensive program of watercourse stewardship to heal the river and it tributaries.

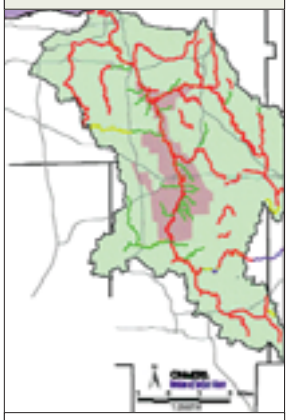
Two principal techniques are often used to restore urban riparian areas (i.e., riverbanks and wetlands) and reestablish watercourses' hydraulic and biological systems of. These techniques include installing permeable bulkheads to protect aquatic habitat, filter pollutants, and prevent erosion; and "daylighting" previously buried streams. (Daylighting is the process of returning a buried stream to as close to its original condition as possible; oftentimes the process requires recreating wetlands.)

The result will be a healthy ecosystem that can maintain a state of dynamic equilibrium and minimize algal blooms, toxicity, and aquatic diseases. A restored river can also increase property values for nearby businesses and residents and offer recreational amenities along the river.

These practices are especially effective when supported by actions that prevent combined sewer overflows (CSOs) into the river (see p. 53 Storm Water).



The primary sources of pollution are municipal discharges, combined sewer overflows, urban run-off, and industrial discharges. TDML non-attainment areas are shown in red.



Source: Division of Surface Water, OHEPA, www.epa.state.oh.us/dsw/tmdl/LowerCuyahogaFinalTMDL.html

The Lower Cuyahoga River has a "Total Maximum Daily Load (TMDL)" limit in effect.[1] The TMDL is part of the Clean Water Act. Its goal is to limit the pollutants a body of water receives in order to meet Clean Water Act specifications. The Cuyahoga has come a long way since 1969, but it still has a way to go before children can safely swim in it and families can safely eat fish from its waters. Currently, the river is not in compliance with water quality standards as shown in the diagram.

The EPA recommends restoration of TMDL-limited watercourses through regulatory, non-regulatory, and incentive-based action.[2] Implementation strategies described here—permeable bulkheads and daylighting—can help the river reach its full regenerative capacity.

Building on a condition that already exists on the site, the bulkhead is perforated to create a cool resting place for fish. This is connected to the daylighted stream by a filtration wetland.

Source: www.cudc.kent.edu/Valley/team3.htm

## Riverbank vegetation and permeable bulkheads

For close to 50 years, bulkheads have maintained a stable bank for shipping and navigation. But after decades of important service, many have corroded to the point that they must be replaced, costing landowners anywhere from $20,000 to $2 million. Worse, they have prevented the river from sustaining itself. In particular, vertical, steel bulkheads:

- Alter natural hydraulic processes;
- Shift erosion points either upstream or downstream, which increases stream velocity;
- Eliminate the diversity of plant and animal species;
- Displace riverbank vegetation that normally protects fish from prey and swift currents; and
- Displace riverbank vegetation that would filter sediment and pollutants before they enter the watercourse.

Natural riverbanks may look pretty, but they also provide several practical services for free: they are habitat for many organisms, including edible fish. They are filters that allow selective penetration of materials and organisms, thereby treating water pollution and minimizing sedimentation. But natural riverbanks aren't compatible with navigation.

[1] The Lower Cuyahoga River Total Maximum Daily Load (TMDL) report was approved by U.S. EPA on September 26, 2003 under Section 303(d) of *The Clean Water Act*. www.epa.state.oh.us/dsw/tmdl/LowerCuyahogaFinalTMDL.html

[2] For more information on the actions, refer to pages 90-93 of the TMDL report at http://www.epa.state.oh.us/dsw/tmdl/LowerCuyahogaFinalTMDL.html

So, what to do? The U.S. Army Corps of Engineers may have found an answer: new designs that offer both biological services and navigability. The agency has embarked on a Habitat Feasibility Study to design an innovative sheet-piling system that is ecologically viable.[3]

[3] Cuyahoga River Valley Initiative Idea Package Summary Working River, p. 3 www.ecocitycleveland.org/pdf_files/workingriver1.pdf

## Liberating watercourses through daylighting

Daylighting is the process of bringing a watercourse that was previously hidden from view, usually culverted and buried, into the "daylight"—to the surface of the land, where it can be seen, heard, and, hopefully, enjoyed. Daylighting reestablishes a watercourse in its old channel where feasible, or in a new channel threaded between building, streets, parking lots, and playing fields. Daylighting projects recreate wetlands, ponds, and estuaries. Subsurface drainage systems can be daylighted to facilitate groundwater recharge and water quality improvements that are provided by natural processes. A promising site for a restoration project in the Cuyahoga River Valley is Kingsbury Run.

## Benefits

### Economic

- River restoration improves property values;
- Riverbank vegetation creates a buffer between the urban areas and the river, filters storm water and urban runoff, and maintains a stable bank. These biological services would supplement the cost and maintenance of bulkhead infrastructure; and
- Daylighting streams would similarly encourage natural processes and decrease the cost and maintenance of culvert and piping infrastructure.

### Community

- A healthy river and tributaries revitalize surrounding neighborhoods by providing new amenities that reconnect people to nature; and
- A healthy river and tributaries offer educational opportunities for schools and community groups studying urban watersheds.

### Environmental

- Riverbank restoration and permeable bulkheads help return rivers to dynamic equilibrium by improving water quality, normalizing water temperature, fostering riverbank vegetation, reducing water velocity, and protecting aquatic animals;
- Daylighting exposes streams to natural processes and to humans, who often start riverbank vegetation initiatives;[4] and
- A healthy river attracts people and increases awareness of "green infrastructure" and the fragility and restorative capacity of natural ecosystems in urban areas.

[4] For full details on Benefits of Daylighting refer to the Appendix 6.

Before and after daylighting

Source: Zürich Sewage Dept.

## Why these measures will work in the Cuyahoga Valley

Inspiring examples of watershed restoration are available as indications of what is possible. Perhaps the most notable is the restoration of the Chicago River and the leadership exercised by the Friends of the Chicago River: a non-profit organization created in 1988. The Chicago River suffered many of the usual maladies experienced by urban rivers: changes to natural flows, storm water and sewage pollution, loss of riverbank vegetation, and declining aquatic populations. Friends of the Chicago River is committed to restoring the river by "providing public access and showing that the Chicago River can be both ecologically healthy and a catalyst for community revitalization."[5] The organization's successes include:

- Establishment of the Chicago River as a model for restoration, including the opening of a new river museum on the Magnificent Mile;
- Leadership in shaping development ordinances and guidelines, including the award-winning Chicago River Urban Design Guidelines and the City of Chicago River Corridor Plan;
- Project such as the Gompers Park Wetlands, the Laflin Street Cleanup, and the Northbrook Riverwalk Project and Nature Trail;
- Education for over 1,200 people per year through volunteer-led canoe trips, walking tours, bicycle tours, and cruises;
- Creation of the Chicago River Schools Network, which has over 200 teachers and their classes involved in water monitoring, cleanup, and advocacy; and
- Restoration workdays such as the annual Chicago River Rescue Day, which involves over 2000 volunteers at over 40 sites.

Daylighting watercourses is a relatively new approach to water management. It is a reversal of the engineering approach that favored linear, underground piping systems. The daylighting of Strawberry Creek at a park in Berkeley, California took place in 1984. While other projects, such as in Napa, California and Urbana, Illinois, re-exposed creeks in the 1970s, the Strawberry Creek project is widely considered the archetypal daylighting project, and it has inspired many other projects.[6] In the past decade, daylighting activity has steadily increased across the United States, and is even more widespread in parts of Europe. In Zürich, Switzerland, more than nine miles of brooks and storm drains have been brought back to the surface since 1988.

[5] For more information refer to their website at www.chicagoriver.org.

[6] Its designer, Douglas Wolfe, now deceased, may have coined the term 'daylighting' to help describe the project to the community.

## Barriers

Barriers to healing watercourses include:

- A lack of awareness of the value of healthy watercourses and the important biological services they provide;
- A lack of awareness of the ways a healthy watercourse can support economic growth and community revitalization;
- The river and stream banks traverse privately-owned properties. Negotiating public-private access is difficult, especially for nature trails along rivers' edges;
- Property owner buy-in is required at the start of the project so that when restoration progresses and land values increase, these owners do not sit on their land hoping for greater financial gain in the future; and
- Heavily polluted rivers and streams can take years to return to health and the benefit of restoration activities may not be immediately visible.

*Before and after:*
*Daylighting Kingsbury Run*

## Implementation strategies

The October 2003 Cuyahoga Remedial Action Plan (RAP) report studied all undeveloped public and private land in the County and created an inventory and assessment of wetlands.[7] The study identified invasive plant species, levels of disturbance, impacts, and restoration potential. A computer map and database were created to show the approximate location of all inventoried wetlands. A similar process can be carried out for restoration within the urban landscape. A new study could identify opportunities for riverbank vegetation, permeable bulkheads, and daylighting where they are most effective in restoring the river.

The U.S. Army Corps of Engineers has made important progress in the area of permeable bulkheads. It is currently developing a habitat feasibility study in the region to redesign the sheet-piling so that it is more ecologically sensitive. The Corps[8] has created a five-step process for installing bulkheads that have a restorative impact on riparian zones:

- Identify areas suitable for potential restoration;
- Develop conceptual restoration alternatives;
- Prepare "typical" design drawings of alternatives;
- Develop cost estimates for construction of alternatives; and
- Prepare a recommendations report.

[7] For full details refer to www.cuyahogariverrap.org/rpt-CuyahogaRAP-report-Oct2003.pdf

[8] For full details refer to *Cuyahoga River Bulkhead and Larval Fish Habitat Investigation: Planning, Engineering, and Technical Assistance* in Great Lakes Areas of Concern, U.S. Army Corps of Engineers, Buffalo District. By Michael Greer et al.

## Next steps

Daylighting Kingsbury Run could have important ecological and development benefits for the Cuyahoga River Valley. It has been identified as an "impaired waterway" in the TMDL report and is "dead" in the sense that it does not have any aquatic life or biological value. It is an urban stream that has been culverted for much of its length and receives significant flows from the North East Ohio Region Sewer District's (NEORSD) combined sewer overflow systems. The NEORSD and the old Sohio refinery both installed in-stream treatment devices and the current landowner continues to maintain this device. As identified in the images below, daylighting Kingsbury Run would have a dramatic restorative impact on the surrounding areas.

- Talk with Friends of the Chicago River to determine what worked and didn't work;
- Consider a GIS-based wetlands inventory and restoration assessment (similar to the 2003 Cuyahoga RAP) for the urban reaches of the Cuyahoga River;
- Develop a detailed vision for a restored Cuyahoga River;
- Determine the status of the U.S. Army Corps' work on bulkheading in the region. Explore opportunities for pilots, public-private partnerships, and linkages to the tow-path trail; and
- Develop a pilot project at Kingsbury Run to test ideas and gain experience.

*Daylighting Kingsbury Run*

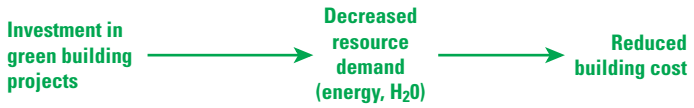
*Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Oberlin, Ohio (www.oberlin.edu/envs/ajlc).*

# Green Buildings

**More affordable, comfortable, and livable for occupants, "green buildings" can also be more profitable for investors and owners. This creative development practice is superior to conventional design because it seeks to integrate each building into a larger system. Like many whole-system solutions, green buildings achieve multiple goals, including:**

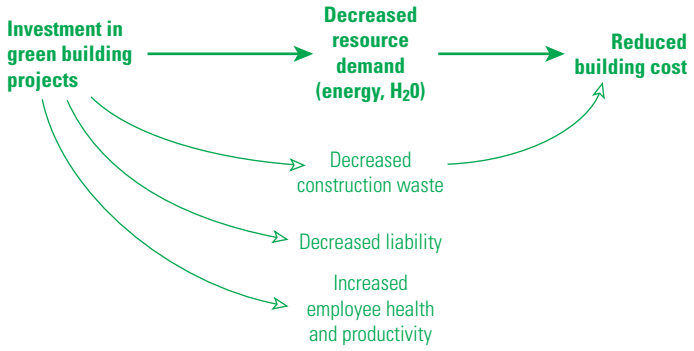
- **Resource efficiency**—maximizing the efficient use of resources in the design, construction, development, and operations of buildings and communities;
- **Environmental sensitivity**—benefiting the surrounding environment;
- **Attention to human well-being**—fostering community in design, construction, and operations; and
- **Financial success**—Green Development is not an altruistic pursuit carried out by developers willing to lose money in the name of the environment.

1



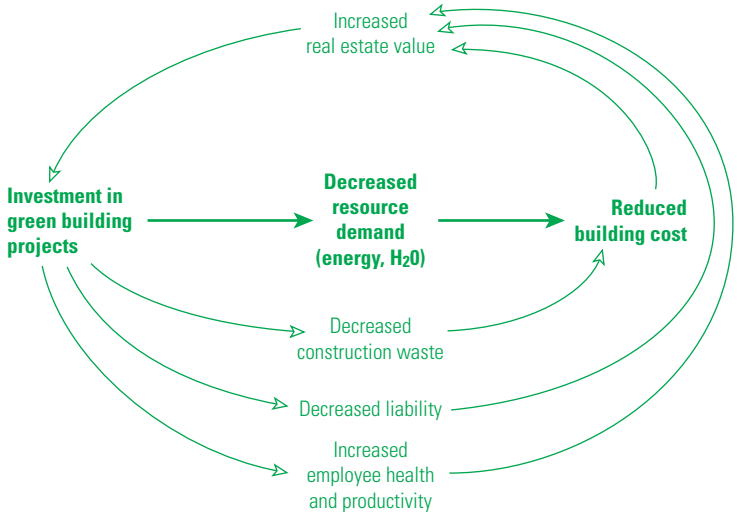

Green-building projects, especially those for commercial and industrial buildings, tend to require fewer resources. For example, well designed, they don't require conventional heating and cooling systems. The result is reduced building cost.

2




These projects tend also to generate less waste. Worker productivity tends to increase in green buildings. Also, these project decrease liability, for example, by improving indoor air quality, which avoids employee lawsuits prompted by "sick building syndrome."

3




These factors increase the value of buildings, resulting in higher rents or sales and stimulating the market to increase the supply of green buildings.

These diagrams only begin to illustrate the inter-relationships among many factors. They do not reflect full complexity or all opportunities.

Bringing these elements together and capitalizing on their interconnections is the key to realizing multiple environmental and economic benefits. Much effort toward building green is already underway in Cuyahoga County. The Cleveland Green Building Coalition (CGBC) leads this effort locally, facilitating green development with a team of consultants, primarily locals. The CGBC works closely with the U.S. Green Building Council to educate professionals using the Council's green building rating system, LEED (Leadership in Energy and Environmental Design).

New building projects in the Regenerative Development Zone could offer an opportunity for the incorporation of green building principles. Regeneration efforts focused on existing industry structures could also be explored. Site-specific design workshops (or *charrettes*[1]) could be held to explore interconnections among such factors as:

- Energy-saving design and engineering;
- Functional design concepts;
- Restorative site development;
- Worker productivity enhancements;
- Transportation and people flow; and
- Environmental sensitivity in design and construction decisions.

The process of designing, documenting, and completing high-level LEED buildings in the Regenerative Development Zone would serve as a model for the Valley's design and development professionals. Also, it would help citizens understand the benefits of building green.

### Why Build Green?

- **Materials:** The building industry uses 3 billion tons of raw materials—40 percent of total global use.
- **Energy:** 40 percent of the world's energy is dedicated to construction and operation of buildings.
- **Water:** The building industry uses 16 percent of global fresh water annually.
- **People:** The "built environment" is humanity's largest artifact. People spend over 90 percent of their time indoors.

[1] **Charrette:** The term *charrette* is borrowed from the field of architecture and refers to an intensive workshop bringing together a group of stakeholders and experts to address planning or design. Charrettes may last a few hours or a few days, and can occur as part of the initial planning process or as part of the building design process. Participants collaborate, sharing ideas and devising recommendations that can later be refined into specific designs.

## Benefits

The benefits of building green include the following:

- Reduced capital costs;
- Reduced operating costs;
- Marketing benefits: free press and product differentiation;
- Valuation premiums (the increased value assessed on a high-performance green building as compared to a conventional building) and increased absorption rates (faster lease-ups or sales);
- Streamlined approval in many jurisdictions;
- Reduced liability;
- Improved employee health and productivity;
- Being ahead of regulations;
- New business opportunities;
- Enhanced culture and community; and
- The satisfaction of doing the right thing.

## Why this idea will work in the Cuyahoga Valley

The Cleveland Green Building Coalition is thriving; its projects include:

- A resource mapping project;
- A deconstruction-waste-capture program;
- Various demonstration projects;
- Greening of the County administration building;
- A landfill diversion project;
- Historic-building tax credits; and
- Green building codes.

The CGBC is housed in the Cleveland Environmental Center, which brings together a network of environmentally minded organizations.


*Cleveland Environmental Center*

## Case Study

Eco Trust; Portland, Oregon

Ecotrust's transformation of a former center for goods transport in Portland, Oregon into its new headquarters speaks well for this conservation organization. The 1895 building, known until recently as the Rapid Transfer & Storage Co., was purchased with a generous donation from Jean Vollum for the Portland-based organization. EcoTrust works in coastal communities from Northern California to Alaska in support of integrating conservation and economic development. The building serves as a sustainability demonstration laboratory in an urban setting. It is also one of the first parts of an overall redevelopment of the Portland River District. It houses a mixture of tenants, from environmentally focused businesses to non-profit organizations. Overall, the project achieved a 98 percent recycling and reclamation rate on construction debris. All of the carpets are made from recycled fibers, all of the paints used were of low-toxicity, and all materials were selected with their environmental and health impacts in mind. The Center was awarded the LEED™ Gold rating certification. Nationwide it is the first restoration of a historic structure to earn this rating. It is also a Portland General Electric Earth Advantage building.

## Barriers

- Lending institutions tend not to support or incentivize best practices for green building, and many have yet to recognize its investment value or its inherent value to building quality;
- Despite the growing popularity of green building and a number of international showcase projects, a wide gap remains between the achievements of building pioneers and the industry at large—between what is achievable from a building technology perspective, and what is practiced in the marketplace;
- Developers, a key stakeholder group for green building, are the least represented group in the green building movement. Further, little material of relevance to developers regarding green building has been published;
- Building officials, buyers, and users often don't understand the features that distinguish a high-performance green building or its advantages.

## Implementation strategies

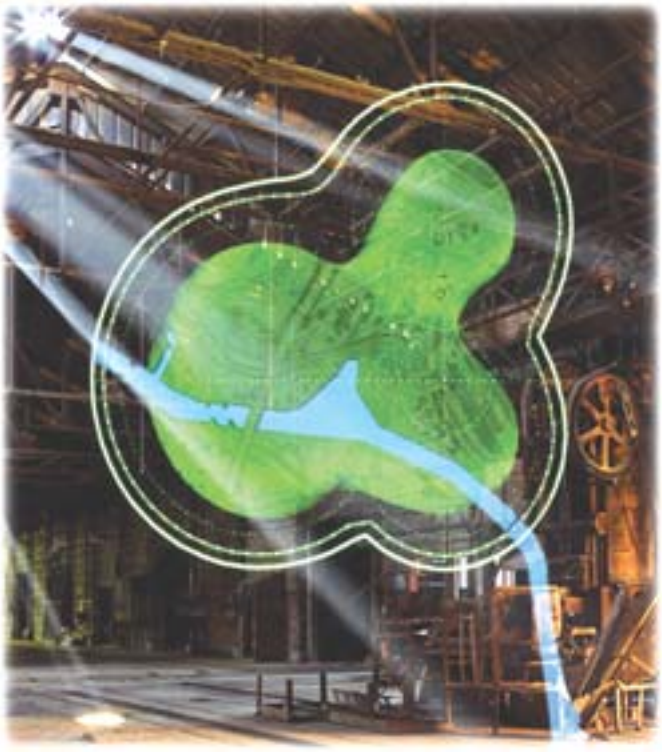
Support the Cleveland Green Building Coalition in the following programs:

- Create a commercially available "green building loan program" to stimulate interest in the broader market;
- Launch a series of leadership profiles of developers who have undertaken green projects, tapping into media opportunities and professional honors to highlight their achievements;
- Hold green-design charrettes on proposed building projects in the Regenerative Development Zone;

- Involve design professionals, general contractors, and builders early in development processes. They will inform important building decisions;
- Provide training on the construction of green buildings;
- Develop educational materials on green buildings specifically targeted to Cuyahoga County developers;
- Create a coordinated approach to utilizing local and/or environmentally responsible materials. Create a database to help inform the design community on such material choices. Start a warehouse business to facilitate the exchange/sale of green building materials;
- Encourage new businesses to be housed in green buildings; and
- Catalyze media coverage on such topics as healthy homes, indoor air quality, healthy work places and schools, energy efficiency, innovative building, and the achievements of state leaders in green development.

## Next steps

- Write green-building articles in local professional journals and the Plain Dealer. For example, describe the findings of a recent study by Greg Kats of Capital E, "The Costs and Financial Benefits of Green Building"—which includes such findings as: the financial benefits of green buildings are in the range of 10–15 percent of the building cost and far outweigh the usual 2 percent extra cost for building green;
- Encourage CGBC's outreach activities to further engage professionals and building users in educational seminars, discussions, collaborative workshops, and charrettes. The Green Roundtable in Boston is a good model for such events. Its "green boot camp" sessions provide practical education for designers and their managers using real projects as the content. This enables firms to begin integrating best design into their daily practice and to recognize the important communication points for related disciplines; and
- Work with any proposed project in the Regenerative Development Zone to ensure incorporation of green principles and practice.



See Appendix 5 for green building resources.

# Using Water Wisely

*"Unaware of the realities, Americans expect to receive water of the highest quality, at the lowest price, and in unlimited quality."*

*— Federal Water Policy: Toward an Agenda for Action*

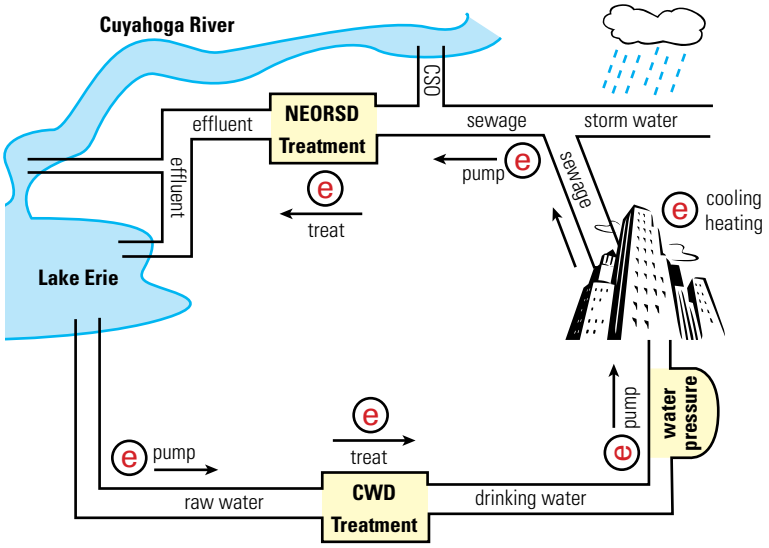
**Wise use of water is effective economic development. It not only saves water, it also saves electricity that would otherwise be required to pump, treat, and distribute wasted water. These two revenues streams can then be spent productively in the local economy.**
**To use water wisely, the Cuyahoga Valley needs:**

- **Incentives that encourage consumers to install water-efficient and Energy-Star-rated fittings and appliances;**
- **Behavioral practices that minimize waste; and**
- **Technologies that improve the efficiency of water and wastewater infrastructure.**

**Water and Energy Nexus**

This diagram shows how water and energy are linked.
Energy is required to pump, treat and distribute water, and storm water is an additional burden on the wastewater treatment process.
By reducing the amount of water used through minimizing wastage and installing efficiency appliances, the community can reduce the total amount of energy required at each step of the process.

ⓔ signifies energy used




**Demands on water and sewage systems increase as urbanization spreads. Therefore, new technology and changes in consumer behavior are required to ensure that water services remain affordable and do not deplete precious natural resources: groundwater, rivers and lakes.**

The Valley's water supply is extracted from Lake Erie. Powerful pumps draw water into the system through four intakes that are located several miles offshore. This water travels through tunnels to the system's four treatment plants. This raw water is treated to drinking-water quality, then distributed to consumers. The Cleveland Division of Water (CWD) delivers water to some 400,000 customers through approximately 5,000 miles of water mains.[1] Once used, wastewater is piped through the Northeast Ohio Region Sewer District (NEO RSD) network of sanitary sewer pipes and treatment plants before being discharged as effluent into the Cuyahoga River and Lake Erie.

[1] For more information see the Cleveland Division of Water website at www.clevelandwater.com/CWDInfo/SysOverview.htm

## Benefits

Large capital- and operating-cost savings are available to both utilities and consumers.

Utilities experience:

- Reduced peak power demands;
- Reduced pumping;
- Reduced wastewater treatment load; and
- Reduced capital costs.

Businesses, residents, and the public sector experience:

- Energy cost savings;
- Reduced water heating;
- Water cost savings; and
- Reduced costs to taxpayers for public sector water and energy use.

The environment experiences:

- Reduced emissions of pollutants; and a
- Reduced burden on natural resources.

The Cleveland Division of Water (CWD) supplies water to over 70 communities, including all of Cuyahoga County and portions of four surrounding counties. Daily pumpage can be less than 150 million gallons per day (MGD), and it can be over 400 MGD, with the average daily pumpage being 260 MGD. The process requires about 2,400 kilowatt-hours per million gallons.

Below is a calculation of the amount of energy savings that might be possible as a result of a 10 percent reduction in water consumption; such a reduction might be possible via a county-wide "Use Water Wisely" education campaign.

260 MGD @ 2,400 kWh/MG = 624,000 KWh/day

624,000 x 365 = 227,760,000 KWh/year

According to an EPA seven million kilowatt-hours per year is enough energy to power 700 homes for a year (see www.epa.gov/lmop/about)

A 10 percent savings in water consumption equates to 22,776,000 kilowatt-hours per year, which is about three times the conversion rate or enough to power 2,100 homes for a year.

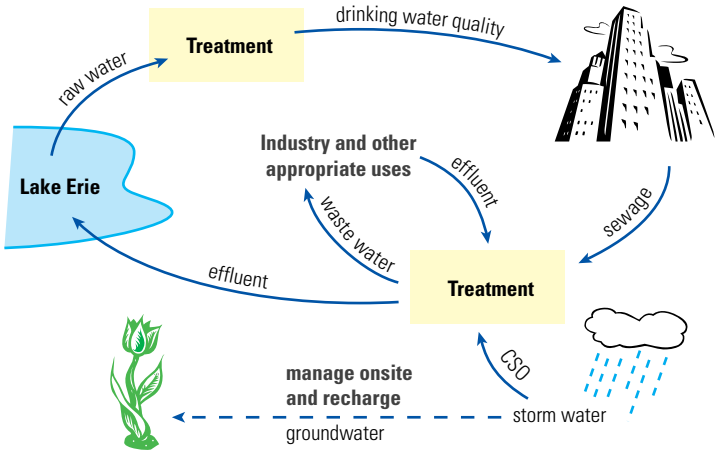
## Why this idea will work in the Cuyahoga Valley

Efficiency strategies that reduce water and energy waste have been documented in many cities and regions worldwide, California in particular. Given that most water users are located considerable distances from water sources, the water-energy nexus poses a significant challenge for that state's utilities. The high cost of transporting and treating water compels utilities to invest in conservation technology, incentives, and education programs that are both progressive and profitable.

The Metropolitan Water District of Southern California (MWD), which is the largest water utility in the state, embraces water efficiency as an extension of supply. In 2002 the MWD and its member agencies marked a major milestone in their conservation efforts with the distribution of the two millionth ultra-low-flush toilet. Two million ultra-low-flush toilets save approximately 88,000 acre-feet of water annually. Similarly, in the upper San Gabriel Valley the SAV-A-BUC rebate program provides commercial, institutional, and industrial customers with a retrofit rebate for efficient water-use fixtures and equipment. For example, industrial customers may receive up to $700 for cooling tower conductivity controllers, or up to $450 for coin- or card-operated high efficiency washing machines.

Market tools of various kinds have been successfully applied in water management. The cost of these programs is typically less than the cost of simply delivering the water to users, so there is a net benefit to water providers and to end-users (and to the economy and environment).

**Cascading Uses of Water (potential)**
This diagram shows how utilities have the option to provide treated wastewater (grey water) to industries and other appropriate uses. A large amount of energy is required to pump raw water from Lake Erie to the community. Therefore decreasing demand for raw water will yield important benefits by ensuring that high quality water is used appropriately (e.g., drinking and showering).




## Barriers

- Utility programs often focus on selling more gallons and electrons as a means to amortize debt;
- Water users tend not to think about conservation; and
- The price of water does not necessarily reflect the true cost of treatment, distribution, and discharge.

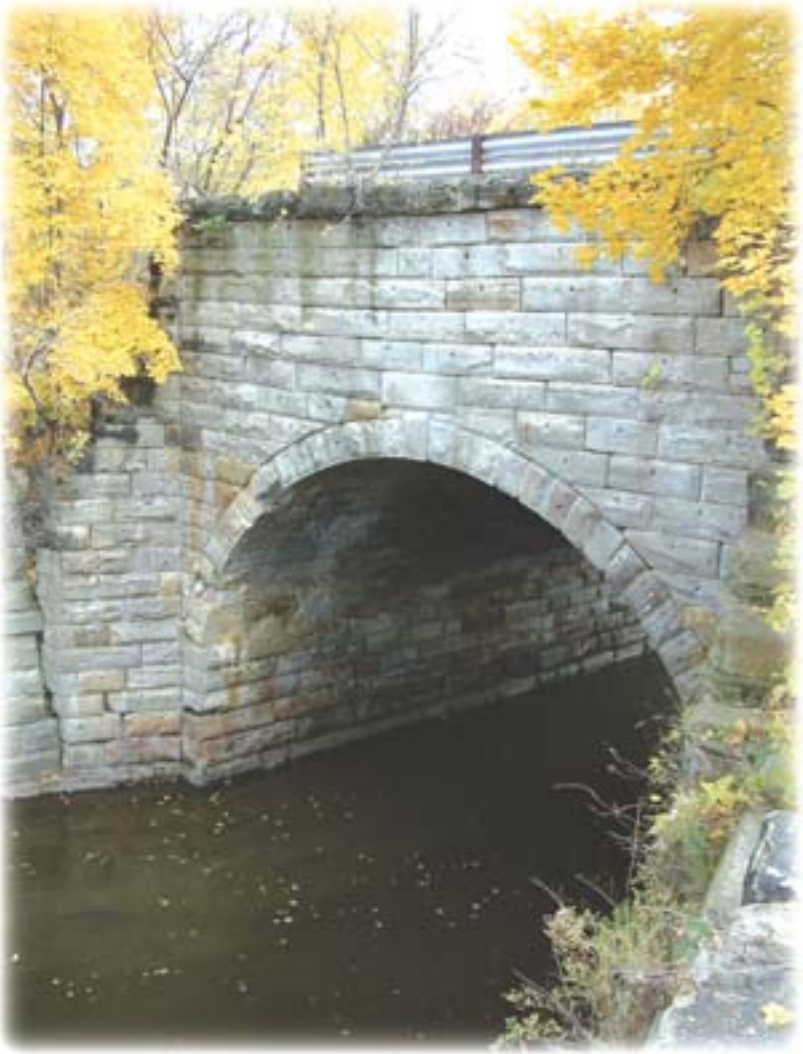
## Implementation strategies

- Develop incentives to encourage utilities to provide services and performance rather than gallons of water and watts of electricity. Analyze the water system's supply and demand and reconsider how utilities value, supply, and consume water. Ask:
  - Are we being water-wise? Do we waste water?
    - Have households installed water efficient and Energy-Star-rated technologies such as ultra-low-flush toilets, washing machines, and spray nozzles?
    - Have incentives been offered to developers to use Energy-Star- or Build-America-approved fittings and appliances?
  - Are we providing water efficiently?
    - Have we designed pumping systems to optimize efficiency through coordinated sizing and configuration of pipes and pumps?
    - Have we located pumping stations in the most energy efficient locations so that water is not pumped uphill?

  - Are we extracting water in the most effective way and minimizing our reliance on the lake?
    - Do we encourage the cascading use of water—for example, using rainwater on gardens or using recycled water for irrigating golf courses?
    - Are we providing incentives for industries to recycle water and reduce their reliance on potable water?
- Create educational programs and incentives to persuade builders and trades people to install water- and energy-saving appliances in new buildings;
- Create educational programs and incentives to encourage landscapers to plant native vegetation;
- Explore co-investment by water, wastewater, and energy utilities in decreasing consumer demand for services through technology and education;
- Explore the feasibility of incentive-based water-wise programs for replacement of inefficient technologies, from showerheads in hotels to spray nozzles in restaurants;
- Provide information on Best Management Practices (BMPs) for industry;
- Develop pilot programs to experiment with the effectiveness of water-efficient technologies and practices (e.g., a pilot rainwater rebate);
- Distribute information about the community cost of inefficient water and energy use;
- Encourage the continued development and use of technological innovations in water and energy efficiency and renewable energy;
- Develop participatory, multi-stakeholder processes that leads to the development of better water and energy management practices;
- Explore water pricing approaches that provide more effective signals to consumers;
- Encourage research institutions to develop improved models for understanding hydrology and economics;
- Consider regional land-use policies that discourage sprawl; and
- Consider ways that regulatory policy and market-based tools (incentives and rebates) can be coupled to achieve more effective water management in the Cuyahoga Valley.

## Next step

- Analyze the magnitude of cost saving from selected water- and energy-saving programs.



# Storm Water as an Asset

**Rain might seem to be a plus for the urban environment, watering plants and keeping cities green. Unfortunately, as it runs across the buildings and vast areas of pavement that dominate the urban landscape, rain also picks up oils, pesticides, trace metals, and other pollutants. In an attempt to prevent these pollutants[1] from entering waterways, rainwater is directed into the sewer system for treatment. When rainfall exceeds the capacity of the system, urban runoff and sewage are forced directly into Lake Erie and local watercourses. Called combined sewer overflow (CSO) systems, these wastewater treatment systems can be a significant source of water pollution in Cuyahoga County.**

**To meet this challenge and save money that would otherwise be used for cleaning up waterways and upgrading storm water infrastructure, urban landscapes and buildings can be redesigned to absorb water where it falls, which in turn nourishes local biological systems and recharges groundwater. Such devices and amenities as porous paving stones, cisterns, water gardens, swales, and rehabilitated soils can be part of a larger strategy that manages storm water as an asset rather than a liability.[2]**

*The Lower Cuyahoga River: Total Maximum Daily Load (TMDL)* report describes limits on pollutants that would otherwise compromise the health of the river. Unfortunately, the Cuyahoga Valley and surrounding areas are exceeding those limits as a result of CSOs and other factors.

In response to this situation, water authorities in the greater Cleveland area are planning to invest approximately $1.6 billion dollars over the next 30 years constructing large tunnels to control CSOs that affect the Cuyahoga River, Lake Erie, and other area bodies of water. About $500 million has already been committed. A rigorous effort to find ways to capture storm water as an asset that can be used on individual sites and within neighborhoods may save some of the $1.1 million balance.

Applications of storm water strategies are site dependent. The examples and techniques outlined in the following pages are provided for illustrative purposes. Local soil conditions, permeability, and other community and economic considerations and characteristics must be examined for each specific application.

[1] For more information on urban runoff refer to Appendix 6.

[2] For a comparison of old and new ideas about storm water refer to Appendix 6.

## Nine Techniques of Restorative Redevelopment[3]

1. ***Capturing roof runoff*** in tanks or cisterns for irrigation or indoor use;
2. ***Disconnecting pavement and roof drainage*** systems from sewer lines and directing runoff to adjacent areas of vegetation or to infiltration basins;
3. ***Engineering infiltration basins***—"water gardens," dry wells, and subsurface recharge beds—to collect runoff and allow it to percolate into the soil;
4. ***Planting trees*** to intercept rain;
5. ***Rehabilitating soils*** to increase infiltration rates and pollutant-neutralizing activity;
6. ***Reconfiguring driveways, parking lots, and streets*** so that they are at least partially covered with pervious, vegetated soil;
7. ***Using porous pavements***—special varieties of asphalt, concrete, masonry, and other porous materials that allow water to pass through.
8. ***Routing runoff through vegetated surface channels ("swales")*** to slow its velocity, remove pollutants, and direct it into the soil; and
9. ***Restoring historic streams*** by excavating culverts and creating naturalized open channels.

[3] Bruce Ferguson, Richard Pinkham, Timothy Collins, 1999. *Re-Evaluating Storm Water: The Nine Mile Run Model For Restorative Redevelopment*, Rocky Mountain Institute, http://www.rmi.org/images/other/W-ReevalStormwater.pdf

Retrofitting parking areas and other paved surfaces is also an option. In the example below, the curb has been cut and the landscaping lowered to create a primary infiltration area. Once the initial flows have saturated the landscaping, the storm drain handles the overflow. By diverting a portion of the first flows, the design reduces demands on the storm drain system.

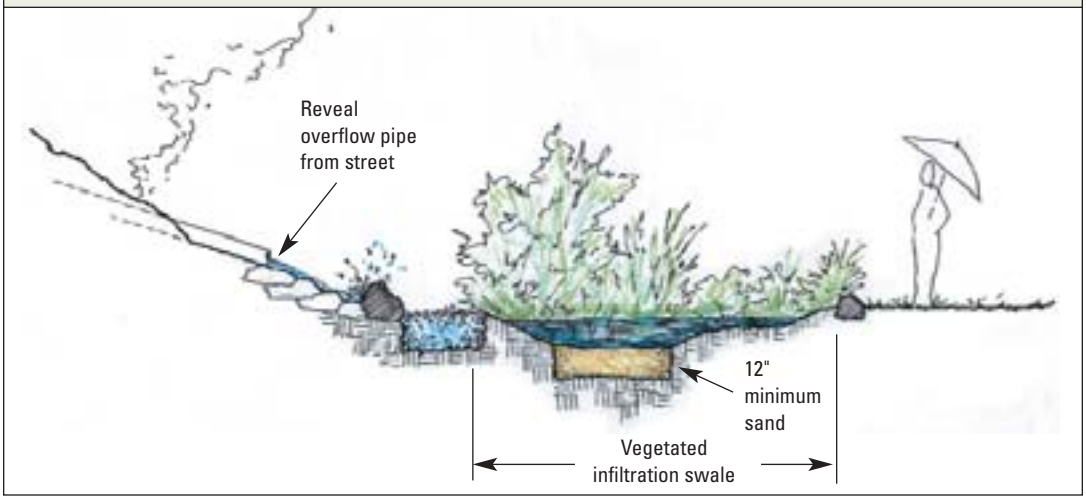
Swales capture down-slope flows and direct them along contours. This slows the rate of runoff and enhances recharge.

Hardscapes: paving technologies are available that allow water to percolate through to the ground rather than running off. While not appropriate for all uses, these paving options offer significant potential for storm water runoff reduction and groundwater recharge.

The role of vegetation in percolation: in all of these designs, plants play an important role. The roots of plants aid percolation, and they allow biological treatment processes to occur. The illustration offers a sense of the root structure and the important function of plants in these systems.

Impervious surfaces generate excessive runoff during storms, which is conventionally routed into pipes or concrete channels, robbing the soil of moisture and bypassing its absorptive capacity. In contrast rain infiltrates into vegetated soil, recharging ground water and supporting plants.

Rainwater catchment: rainwater catchment is not a new idea. Around the world, people have captured rainwater to irrigate gardens and for domestic water supplies. Like storm water recharge strategies, this seemingly simple management approach provides water while reducing storm water flows. Various techniques can be employed to avoid mosquito problems.



## Benefits

### Economic

- Savings to sewer utilities can reduce infrastructure investment intended to limit discharge into the river;
- Savings in the construction and maintenance of curb and gutter (storm water) infrastructure;
- Savings from not having to clean up polluted waterways;
- Increased property value as a result of the creation of green corridors for managing storm water on or near the land where it falls; and a
- Market for green development, including architects, designers, and manufactures of porous and permeable surfaces.

### Environment

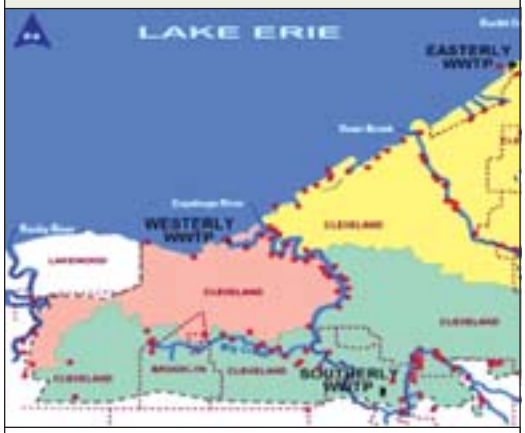
- Watercourses improved or protected to TMDL standards; and
- Restored "environmental services"—the filtering of storm water into the soil; (e.g., micro-organisms decompose pollutants and turn them into nutrients. Water stored in the soil replenishes ground water.)

### Community

- Natural and porous surfaces, along with tree planting and vegetation, beautify and cleanse the urban landscape

This diagram illustrates CSO discharge locations in the Cuyahoga watershed.
A CSO refers to old sewers that carry sanitary wastes and storm water in the same pipe.
The Westerly Waste Water Treatment Plant has seventeen CSO outfalls.

CSO discharge locations are indicated with red dots.




Source: Lower Cuyahoga River Valley TMDL Report, p. 45

## Why this idea will work in the Cuyahoga Valley

1. In 1998, the Nine-Mile-Run-Watershed community in Pittsburgh developed options for reestablishing natural processes in its urban landscapes. This involved a three-day workshop with 60 local and national designers, engineers, artists, planners, policy makers, and local citizens.[4] The outcome of the workshop was a selection of designs for four specific urban sites: a neighborhood school, a neighborhood park, a historic train station in a commercial center, and an underutilized commercial site. Through combinations of retrofitting and redevelopment, the participants chose storm water management techniques shaped by and embedded in the revitalization of the sites.

2. The TMDL process encourages innovative schemes for managing watercourse pollution,[5] and they have been implemented in many watersheds, including Chesapeake Bay and the Kalamazoo watershed. It identifies point sources of pollution (utility and industry sources that have a permit to discharge into the river) and non-point sources of pollution (discharge that are not from a single location, such as urban runoff or storm water). A specific pollution limit offers an opportunity for utilities (and industry) to invest in community-wide urban runoff and storm water strategies that will cost-effectively limit the total amount of pollution entering the river.

[4] The full report, titled *Re-evaluating Storm Water: The Nine Mile Run Model for Restorative Development,* is available from the Rocky Mountain Institute website: www.rmi.org.

[5] For more details on water quality trading schemes refer to the EPA website.

## Barriers

- Lack of awareness that storm water can be separated from the combined sewer network and provide water quality and ecological benefits;
- Conventional methods of storm water management focus on big public works projects (storage tanks, pipelines, treatment plants, etc.) to fix the storm water "problem." Approached differently, the problem disappears and the water becomes an asset;
- Conventional methods of land development replace agricultural and natural ground cover with pavement and other impermeable surfaces;
- Limited knowledge of storm water technologies; and
- New investment and funding mechanisms, such as pollution trading schemes using BMPs, need to be identified.

## Implementation strategies

- Conduct an education campaign that broadens the concept of storm water infrastructure to include soil and vegetation, which absorb water and filter pollutants;
- Explore the feasibility of a water quality trading scheme funded by utilities in the Valley;
- Develop expertise in water systems. Identify businesses that are engaged in this field and discuss possible business ventures around Cuyahoga-specific expertise;
- Build a market for storm water friendly technology and encourage local manufacturers to invest in porous materials for roads and paving;
- Fund best management practices (BMPs). The U.S. EPA has endorsed BMPs[6] as a method to control pollution-producing activities and reduce or eliminate the introduction of pollutants into watercourses. BMPs are proprietary (patented and/or manufactured) or nonproprietary (in the public domain). Examples of proprietary BMP products are Stormceptor and GravelPave. Examples of nonproprietary BMPs include detention basins, grassy drainage swales, catch basin stenciling, and public education.

[6] The USEPA maintains an extensive list of BMPs on its "technology fact sheets"; see www.epa.gov/owmitnet/mtbfact.htm

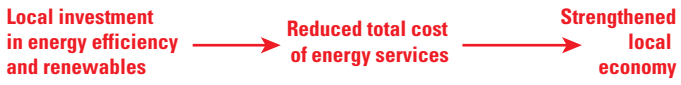
# Energy Investment Strategy

**An innovative and forward-looking mix of energy resources—notably renewable energy sources and energy efficiency—in the Cuyahoga Valley and the surrounding region would lead to greater energy security, lower consumer costs, less air pollution, more local jobs, more reliable power, and enhanced economic development.**

**Unfortunately, the current energy regulatory environment in Ohio pushes investment toward centralized fossil-fuel power plants, which not only prevents areas such as the Cuyahoga Valley from realizing innovative lowest-cost energy services, but also perpetuates pollution, a stagnant economy, and an unreliable electric grid.**

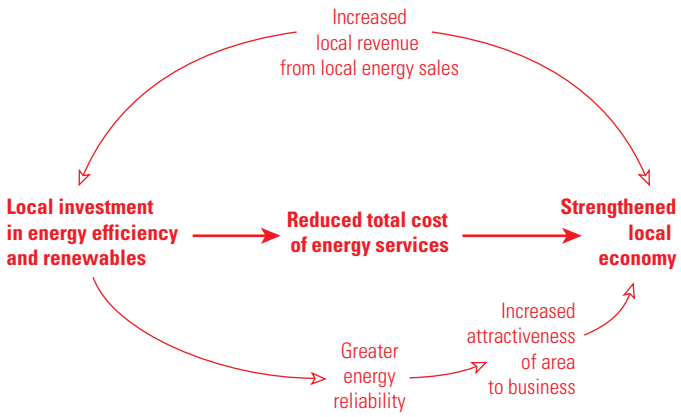
**In order to optimize energy resources, investments must be made in other supply-side technologies, such as distributed cogeneration of heat and power[1] and renewable energy technologies, as well as demand-side technologies, such as energy efficiency. The first step toward realizing the best possible mix of energy resources for the future is to undertake an in-depth, area-specific study, such as an Energy-Resource Investment Strategy.**

1



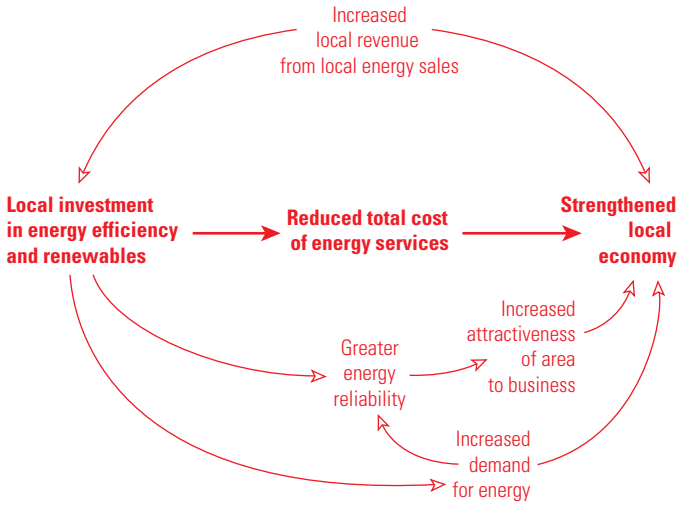

By reducing demand for energy through efficiency technologies, the total cost of energy services will decrease, freeing up disposable income, some significant portion of which will be spent in the local economy.

2




In addition, revenue from local energy sales further strengthens the local economy. Reducing dependence on the centralized energy grid, local energy projects will increase energy reliability, making the area more attractive to many businesses. Also, increased business activity increases energy demand, potentially leading to additional investments in energy efficiency and renewable sources.

3




Increased business activity leads to increased demand for local energy from new companies, providing revenues for further investment in efficiency and renewable sources.

These diagrams only begin to illustrate the inter-relationships among many factors. They do not reflect full complexity or all opportunities.

[1] **Cogeneration** is the simultaneous production of electricity and thermal energy (in the form of hot water or steam). The thermal energy that would otherwise become waste heat is captured and used, thereby increasing the overall efficiency of the system.

## Benefits

The efficient use of energy through distributed resources[2] could realize both economic and social benefits for the Cuyahoga Valley region. The economic benefits include:

- Savings on energy bills. Energy bills are reduced through the use of more efficient equipment and appliances;
- Increased power quality and fewer power outages. For many of the industrial and commercial facilities in the Valley, it would be feasible to cogenerate heat and power on-site to complement the existing power grid and to provide premium power reliability, which would reduce costly losses in productivity that result from regional power outages; and
- A more robust local economy. Encouraging distributed resources has been shown by U.S.Environmental Protection Agency (EPA) studies to stimulate local economies by increasing the purchase of energy efficient technologies and reducing the flow of money to power producers outside the region. In one EPA case study, it was estimated that an investment of $1 million in energy efficiency resulted in the creation of more than ten new jobs on a net basis.

Social benefits include:

- Reduced pollution. Consuming less energy reduces the amount of fossil fuel burned in power plants, which directly reduces the amount of harmful emissions, such as greenhouse gases, that these plants release into the atmosphere. The emission of sulfur oxides, nitrogen oxides, other chemicals and metals, and harmful particulate matter that cause or exacerbate asthma would also be reduced; and
- Increased safety. In addition to the economic benefits of increased reliability of the electric grid, distributed resources would also enhance the region's resiliency to blackouts, which in turn would result in increased security for residents and businesses.


[2] The term **distributed resources** includes both energy efficiency and distributed generation. Distributed generation refers to small generation systems widely distributed throughout an area, close to the places where the energy will be used.

[3] **Pay-As-You-Save** is a financing method in which a utility or other entity covers the up-front expenses of energy efficient technologies for an energy user. The end user then repays this amount over time by paying back a portion of the value of the energy saved through the monthly utility bill.

[4] An **efficiency utility** is an independent, non-profit organization separate from the supply utilities that consolidates and administers efficiency programs for a state or other jurisdiction.

## Why these measures will work in the Cuyahoga Valley

Energy efficiency programs and policies have been successfully implemented in many parts of the country, notably Wisconsin, Minnesota, California, New York, the Pacific Northwest, and New England. Ohio has not implemented such programs vigorously to date, and therefore savings similar to those achieved in other states can be expected as a result of future efforts in Ohio. Studies in other states have shown that every million kilowatts saved annually (an average medium-sized office building uses three to five million kilowatts each year) is worth about $600,000 in savings over the lifetime of the efficiency measures. Factoring in capital and operating costs, this is about $300,000 in net present value. Additionally, these savings reduce carbon dioxide emissions by about 1,000 tons per year.

Cuyahoga County is also nearing a point where some form of investment in energy resources will be necessary in order to ensure adequate supply in the future. AMP-Ohio is currently studying the feasibility of constructing a new coal-fired plant that would generate between 500 and 750 megawatts and cost between $750 million and $1 billion (Cleveland's share would be 175 megawatts).[5] Conducting an ERIS could reveal other means to satisfy the area's increasing demand for energy services, both at lower costs and with less negative impact on the environment and community.

### Energy-Resource Investment Strategy (ERIS)

An ERIS starts with a detailed regional analysis of existing resources and transmission capacity. Also, it identifies the costs and other viability factors for various types of new generation capacity, as well as opportunities for improvements in energy efficiency. Energy saved through energy efficiency measures, called "negawatts," serves the customer as well or better than new generation capacity, or "megawatts." An ERIS analyzes several future scenarios for the area, based on possible growth trajectories for energy demand, as well as the availability and cost of new and developing technologies. For each of these scenarios, an optimal mix of supply- and demand-side resources is described, based on the minimization of economic and environmental costs and risks.

The results of the ERIS inform local leaders of what investments should be made on a regional scale in order to obtain the best possible energy services at the lowest overall cost. However, in order for these investments to occur, existing disincentives and barriers must be addressed through new policies and programs, as well as through innovative financing methods such as Pay-As-You-Save,[3] or a dedicated efficiency utility,[4] funded through an increase in Ohio's system benefits charge on utility bills.

[5] Crain's Cleveland, May 19-25 "Study to determine if state has need for new power plant." See http://crainscleveleand.com/search.cms for more details.

## Barriers

### *Barriers to conducting an Energy-Resource Investment Strategy*

- An ERIS is typically funded by a public or private utility. However, given the current regulatory environment in Ohio, these entities may have little incentive to undertake such a project, let alone to put the results of an ERIS into practice. In their absence, another organization must be found to take the lead in conducting an ERIS.

### *Barriers to distributed resources*

- From the customer perspective, barriers include:
  - A lack of information on available technologies and their benefits;
  - A lack of access to capital at low (or even high) cost;
  - Complex and expensive interconnection requirements for distributed generation;
  - Unfamiliarity with distributed resource technologies (which often leads to unduly high perceptions of risk in comparison to other expenditures);
  - A lack of means to enable borrowing against future savings to finance capital improvements; and
  - Split incentives between, for example, building owners and occupants (the owners make investments in efficiency, but occupants pay the utility bills).
- As a result of the state's deregulation, old utilities and new providers who are now entering the market compete only on wholesale and retail rates. While this is expected to result in a more efficient market and cheaper power, it also creates a disincentive for utilities to invest in energy efficiency or distributed generation because such investments often require a small increase in energy rates to cover capital costs, which could reduce the utility's competitiveness. Often misunderstood, however, is that these investments would also result in ratepayers using less energy, which would actually lower their bills on a net basis, despite the potentially higher rates. Thus new policies are required to realize both lower bills and the other benefits of energy efficiency and distributed generation.

## Implementation strategies

Strategies to overcome barriers to investment in energy efficiency, including distributed cogeneration, can be developed at three levels:

- ***Buildings and facilities.*** To capture its energy-efficiency potential, a facility must identify energy waste, specify technology upgrades, and finance the capital improvements. Third-party energy service companies (ESCOs) can deliver all these services in a turnkey package. However, in most cases, the facility should first perform an energy audit to identify efficiency opportunities or use pinch analysis[6] or another method to find heat recovery or cogeneration opportunities. Though energy efficiency measures are much easier to implement and less expensive in new facilities, many are economic in existing facilities as well;
- ***Cities and communities.*** Local energy codes and standards are important tools for reducing the energy-demand burden that new buildings impose on the community's energy system. Local governments and nonprofit organizations can provide information on energy use and efficiency opportunities, and they can facilitate efficiency investments by increasing contacts between energy users and vendors of efficiency or cogeneration services. Municipal utilities can be strong advocates of, and investors in, energy efficiency (as in Seattle and Sacramento), but the utility industry structure in Ohio currently discourages such activity in Cuyahoga County and other cities; and
- ***State.*** State governments create most electricity policy and regulations. In most cases, state regulatory commissions are the forces behind utility programs that promote energy efficiency. Though utility-based energy-efficiency programs are effectively discouraged by Ohio utility policy, it might be possible to increase the state's system benefits charge (SBC)[7] to fund efficiency improvements and create an efficiency utility separate from the energy-supply utilities. Additionally, the State could coordinate the lower price purchase of large volumes of efficient technologies, and install them in State facilities.

[6] **Pinch analysis** uses the principles of thermodynamics to maximize the efficiency of a system by analyzing energy- and material-flows.

[7] A **system benefit charge** is a charge added to a consumer's electric bill. Proceeds are put into a fund used to cover costs that benefit everyone in the community, such as energy efficiency or renewable energy. SBCs evolved as a type of ratepayer-funded efficiency program in the aftermath of electric-utility restructuring in the 1990s. Under these restructuring initiatives, utilities lost significant incentive to invest in energy efficiency and other forms of demand-side management. As a result, energy efficiency funded by electricity users also dropped rapidly. Several states addressed these developments by establishing funds earmarked for energy efficiency projects.

## Next steps

### *Community wide*

- Conduct an Energy-Resource Investment Strategy for the Cuyahoga Valley or the wider region. The best type of organization to undertake such a project may be an educational institution or nonprofit organization. Because the process would benefit all residents and businesses in the area, funding should come at least in part from the State or municipalities.

### *Facilities and Communities in and around the Cuyahoga Valley*

- Perform energy audits to identify efficiency options and use pinch analyses and other methods to find heat-recovery and cogeneration opportunities. Municipalities could mandate such audits in their facilities. Grants (such as those funded by a system benefits charge) could be provided for audits at commercial or residential facilities.
- Disseminate case studies demonstrating quick and inexpensive efficiency gains through building-energy commissioning.[8]
- Investigate the potential for the use of shared waste-heat across facility boundaries, as described on p. 67, "Cogeneration." Municipalities could lead this process by cataloguing existing pipe infrastructure and performing audits of consumption and production of thermal and electrical energy at these facilities. A cogeneration network would result in energy savings and increased implementation of distributed resources.

[8] **Building energy commissioning** is a process that tests a building to ensure that it performs in accordance with the design intent and estimated performance.

- Identify internal mechanisms (e.g., connecting operating to capital budgets) that enable borrowing against future savings to finance efficiency investments that require more than a one-year payback. Disseminate case studies. Identify external mechanisms such as energy service companies (ESCOs) that provide turnkey solutions. Also, identify financial service companies that are familiar with the economics of energy efficiency and distributed resources and are therefore willing to provide loans at affordable rates. Disseminate a list of these.
- Disseminate information on energy efficiency opportunities and available rebates, and case studies of the financial effects of installing energy efficient technologies.
- Review municipal energy codes and standards to identify options for raising standards.

*State of Ohio*

- Investigate the options for Ohio to create incentives for utility investments in efficiency and to decouple utility revenues from sales volume.
- The Ohio Department of Development's Office of Energy Efficiency is currently considering how to best distribute funds from the system benefits charge (SBC) in the form of grants and loans for energy efficiency and/or distributed generation. The State should assess the potential to increase the SBC as a way to fund more of these projects.
- Consider using SBC funding to create an "efficiency utility" that is separate from the supply utilities. Vermont and Oregon created efficiency utilities (e.g., Oregon Trust) to administer efficiency programs in the wake of electric utility restructuring. The efficiency utility is an independent, nonprofit organization that must sustain itself with SBC funds and returns from investments in energy efficiency. It consolidates and enhances most of the programs previously offered by the state's electric utilities and provides a streamlined and coordinated approach to energy efficiency.

## Next steps (*State of Ohio*, continued)

- Identify new and innovative financing mechanisms for energy efficiency, such as Pay-As-You-Save. Often the single largest barrier to widespread adoption of energy efficient technologies is consumers' unwillingness to pay a higher upfront cost for efficient devices than for conventional products. PAYS® allows energy users to acquire energy-efficient technologies without making upfront payments. A utility or third party covers the upfront expense of the efficient technology while the customer repays this amount over time by paying back a portion of the value of the energy saved through the monthly utility bill. This mechanism ensures that the customers who pay for the energy-efficiency technologies are also the ones who realize the savings.
- Support changes in regulations that would standardize interconnection laws based on the technology. This would reduce the cost of developing a distributed-generation project.

# Energy Cogeneration Network

**The Cuyahoga Valley is currently wasting resources that could be put to work saving money and reducing pollution in Cuyahoga businesses. One of those resources is waste heat from the generation of electricity,[1] which is valuable for such uses as space heating and industrial processing. Currently, much of this thermal energy is simply vented. However, capturing and using it, a process called cogeneration, is both economically and technically feasible. Cogeneration is the concurrent production and use of both electricity and thermal energy, which saves money and reduces pollution by using fossil fuels more efficiently.**

**The Cuyahoga Valley offers an unusual opportunity to realize the benefits of cogeneration due to the high concentration of industrial facilities within a small area. Today, many of the industrial facilities that generate part of their own electricity release the unwanted thermal energy in the form of hot water or steam to the atmosphere. This waste occurs either because the facility isn't set up to capture the heat, or because their processes don't need all of the heat available. However, by developing a network of hot water pipes or underground steam tunnels linking these facilities, one business can sell excess thermal energy to another. Cogeneration is one form of distributed generation.[2]**

[1] When electricity is generated, inefficiencies in the generation technologies turn as much as 60–70 percent of the fuel burned into waste heat instead of electricity.

[2] As described in "Energy Investment Strategy", distributed generation refers to the use of small generation technologies, such as microturbines, small fuel cells or engines, located at or near the points at which the energy they generate will be used.

## Benefits

The relationships that would result from a cogeneration network would be complementary for all involved, including the following:

- Producers of thermal energy, who would receive a new source of revenue;
- Recipients of thermal energy, who would pay a lower overall price for it than they would if they were to make it themselves or buy it from a utility. Also, they could avoid expensive increases in boiler capacity at their own facilities;
- Utilities, who could benefit by deferring investment in new capacity;
- All grid users. Enabling an industrial facility to sell recovered heat at a profit would increase the economic viability of cogeneration systems, thus encouraging installations of more cogeneration systems, which would increase the resiliency of the electric grid,[3] which in turn could help avoid the inconvenience, economic losses, and other potential hazards associated with power outages.
- The entire community of the Cuyahoga Valley, as well as those beyond it, which would benefit from the reduction both of natural resource consumption and of the emission of pollutants; and

## Why cogeneration will work in the Cuyahoga Valley

- The technology needed to create the infrastructure of a cogeneration network is well established. Indeed, the idea of distributing hot water or steam between buildings or facilities dates back to the Roman era. Today, numerous municipalities, companies, and private utilities own and operate district-heating systems[4] through which steam or hot water are distributed from one or more suppliers to one or more recipients.
- Certain areas in and around the Cuyahoga Valley already contain piping infrastructure that could be used, converted, or upgraded to be part of a cogeneration network. The use of these systems could reduce the upfront capital cost of realizing such a network.
- Much of the existing piping infrastructure is old and probably leaky, particularly those segments that are no longer in operation. The capital cost to upgrade these pipes and install new ones to complete a network could be significant.

[3] Multiple small, distributed generation units are less susceptible to widespread power outages than are large, central power plants. One reason for this is that the effect of an electrical disruption can be minimized if a large percentage of loads are served by generation close to the load rather than from power transported from plants hundreds and thousands of miles away via overloaded transmission lines. Additionally, under proper regulatory and technological conditions, distributed generation units can supply emergency power to others in the surrounding area.

[4] A partial list is available at www.energy.rochester.edu/us/comdhlst.htm.

## Barriers

- Installing new pipes beneath public thoroughfares to distribute thermal energy could meet regulatory hurdles.
- Some facility managers may be hesitant to rely on thermal energy from a company that could move, change production processes, or go out of business.

## Implementation strategy

- Identify sites and facilities appropriate for inclusion in the network. Estimate cost.
- Identify potential regulatory barriers to the network.
- Identify the particular cogeneration technologies (such as fuel cells, microturbines, or reciprocating engines) that are most appropriate for this area. This could be accomplished as part of an Energy-Resource Investment Strategy (ERIS).[5]
- Analyze in detail the existing piping capable of carrying hot water or steam, including both public and private systems. Data should include pipe location, age, condition, material, capacity, and ownership.



- Develop a request-for-proposal (RFP) from engineering firms to estimate the cost of completing and/or repairing the network.
- Consider waiving the public right-of-way fees[6] normally charged when pipes cross public thoroughfares. This may require that the network be owned and operated by a municipality or non-profit, or exist as a not-for-profit entity.
- Analyze energy supply and demand for all facilities in this region.[7] Include how much thermal and electrical energy each facility is generating, and how much electrical and thermal energy each uses. Develop load curves[8] and production profiles[9] for each facility, ideally including data for each hour over a year. This information is important because energy is consumed and produced at different rates at different times of the day and year, and creating a self-sufficient network would require estimates of how much energy would be demanded and available at any given hour.

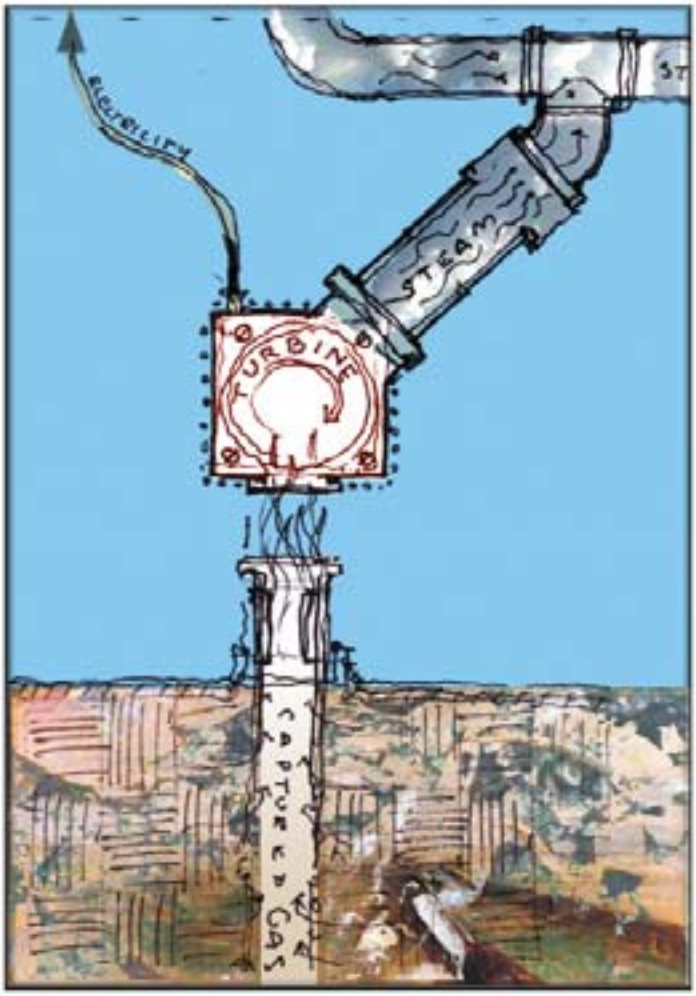
[5] For a more complete description of ERIS, see "Energy Investment Strategy," p. 59.

[6] Ohio Revised Code Chapter § 4939.05, paragraph (2) reads "A municipal corporation may waive all or a portion of any public way fee for a governmental entity or a charitable organization."

[7] Again, such information would be collected as part of a detailed study such as an ERIS.

[8] Load curves show the amount of energy (both thermal and electrical) used during each hour of the day.

[9] Production profiles show, for those facilities with a distributed generation system, the amount of each type of energy (thermal and electrical) being produced at any given time.




landfill gas

# Waste to Energy

**Many forms of waste, once regarded as problems, are now being considered opportunities. Innovative businesses are converting waste into useful, profitable resources, including energy. There are two processes in particular for converting wastes into energy that show promise for the Cuyahoga Valley: methane-gas capture at landfills and the gasification of industrial, medical or municipal wastes.**

**The first process, capturing methane gas from landfills and using it to generate electricity, is a proven, economically viable activity that holds immediate and significant potential for the area. Landfill gas is formed when organic waste in a solid waste landfill decomposes. The gas usually consists of about 50 percent methane (the primary component of natural gas) and about 50 percent carbon dioxide. The methane can be captured and burned to generate electricity, instead of allowing it to be lost into the air. Capturing the gas is also much safer than allowing it to remain within the landfill; deadly explosions of landfill methane gas have occurred at various locations.[1]**

**The second process—gasifying industrial, medical and municipal waste, and generating electricity with the resulting gases—holds great potential for the area. In general, this process converts waste into production-ready gas in two stages.**

**First, waste is broken into its constituents by applying heat and pressure in a low-oxygen environment. In effect, it is cooked rather than burned. In the second stage, the resulting gas is cleaned and burned to produce electricity and/or thermal energy. These two stages reduce the amount of pollution that is released when the waste is processed, while simultaneously producing valuable energy.**

[1] See www.atsdr.cdc.gov/HAC/landfill/html/ch3.html; scroll down to "Landfill Gas Explosions."

## Benefits

- Waste substances that previously caused storage and pollution problems become resources that generate economic value and jobs, without increasing the rate at which natural resources are processed.
- There is significant potential for cogeneration from methane capture at landfills in the Valley. The Ohio EPA's Division of Air Pollution Control (DAPC) estimates that a total of 18 million tons of waste currently sits in the 18 landfills across Cuyahoga County. This waste is currently producing over 34 million cubic meters of methane gas each year. Of these 18 landfills, two hold particular potential for methane capture: the Glenwillow Sanitary Landfill and the Royalton Road Landfill in Broadview Heights. The former was closed recently, and the latter will close later this year. Together, these two landfills account for nearly half of the methane released in the County—over 16 million cubic meters of methane per year. But currently, all of this methane is being wasted. Capturing and burning it could produce enough electricity (over 25 million kilowatts per year) to supply more than 2,500 local homes.[2] Currently, however, there is only one active landfill-gas capture site in the County: the Cuyahoga Regional Sanitary Landfill in Solon.
- Utilizing landfill gas also substantially reduces greenhouse-gas emissions. When methane escapes untreated into the atmosphere, its contribution to global warming is roughly 20 times as great as carbon dioxide's contribution per unit mass. Burning the methane greatly reduces this effect. Capturing the methane emitted from Glenwillow and Royalton Road landfills and burning it to produce energy will have the same effect on reducing greenhouse gas emissions as would removing almost 22,000 cars from the road or planting 30,000 acres of trees.[3]
- Gasification companies could increase incomes by selling energy as well as scrap (such as iron and steel) collected in the process of converting waste into energy.

[2,3] See www.epa.gov/lmop/about.htm.

## Why these measures will work in the Cuyahoga Valley

### *Methane Capture at Landfills*

- Of the 6,000 landfills in the United States, approximately 340 currently capture methane. The U.S. EPA estimates that as many as 500 additional landfills could immediately and cost-effectively turn their methane into an energy source.

### *Gasification*

- Across the country, 29 states are now home to a total of 98 gasification-type waste-to-energy facilities, which process nearly 97,000 tons of waste every day.
- In Cuyahoga County there are 238 organizations creating medical waste. Much of it could be gasified locally using technologies such as the EcoTech Medi-Waste System.[4] The electrical and thermal energy produced by this process could be used efficiently by industries near the site. Sited near an industry that could use waste heat, one of these systems would be an excellent example of distributed cogeneration.[5]
- The U.S. EPA is currently studying the feasibility of converting certain hazardous industrial byproducts into gas, which could be used for power generation. Approved waste-gasification processes are regulated like production or manufacturing operations, which are subject to less-stringent regulations than hazardous-waste-management activities. This will greatly improve the economics of this process.
- The waste from several manufacturing-related facilities in the Valley may be suitable for gasification.

[4] See www.etwm.ca/medi/medi_main.htm.

[5] **Distributed cogeneration** is the capture and use of both electrical and thermal (in the form of hot water or steam) energy from small, modular generation technologies (called distributed generation, or DG).

## Barriers

- Lack of understanding and political momentum has resulted in Ohio utilities being reluctant to purchase power generated from captured landfill gas, which has reduced demand and made investment appear riskier than it is.
- Both waste-to-energy technologies require significant investments of capital and up-front development expenses. Obtaining financing for such lesser-known technologies as these can be time consuming and expensive.
- Despite a large number of successful projects nationwide, the permitting of landfill-gas projects still requires an exorbitant amount of paper work.
- Though air emissions from waste gasification comply with the EPA New Clean Air Act "Maximum Control Technology," such byproducts as ash could still be considered burdens on the environment, and may be subject to regulatory control.

## Implementation strategies

### *Methane Capture at Landfills*

- Incentivize utilities to purchase electricity generated from landfill gas. Incentives could include a renewable portfolio standard (RPS) or the promise of demand for this and other forms of "green power."[6]
- Develop connections between financiers, entrepreneurs, and gas-capture and combustion-equipment manufacturers, through such venues as conferences.

### *Gasification*

- Investigate the economic and technical feasibility of waste-to-energy projects as part of a larger energy-resource study.[7]
- Initiate discussions with waste--producing facilities in the area, such as hospitals and food manufacturers, to determine the economic feasibility of gasification of their waste streams. Such a dialogue could be facilitated by the creation of a State or regional program to promote such projects. For example, grants or loans could be issued from funds collected through the electric-utility system benefits charge (SBC).

[6] One strategy for increasing and insuring demand for this and other forms of green energy would be for municipal governments to commit to serving all or a percentage of their energy needs with energy generated from renewable energy or energy generated from landfill gas.

[7] One form of energy resource study is described in depth in "Energy Investment Strategy."

## Next steps

### *Methane Capture at Landfills*

- Investigate financial and technical feasibility of capturing landfill gas from area landfills, particularly the Glenwillow Sanitary Landfill and the Royalton Road Landfill.
- Investigate barriers to the efficient use of landfill gas.

### *Gasification*

- As part of the area-wide inventory of waste by-products (see p. 27, Industrial Symbiosis) and distributed-generation opportunities (see p. 67, Cogeneration), identify opportunities for gasification.
- Initiate a dialogue between local and national experts in the field of waste gasification. This should be a formal group, such as the Waste-to-Energy Research and Technology Council at Columbia University.[8] American Ref-Fuel,[9] the national leader in gasification, should be part of this group. This firm now has a fully operational gasification plant in Niagara Falls.

[8] See www.seas.columbia.edu/earth/wtert

[9] See www.ref-fuel.com

# Renewable Energy from Wind Turbines

**Wind turbines harness currents of air to create renewable, zero-emission electricity. In many areas, they can generate electricity at prices competitive with fossil fuel-fired power plants. Ohio has several areas with good wind energy potential, including places along the shores of Lake Erie and in several offshore locations.**

## Benefits

Besides providing clean, renewable power, there are several additional benefits:

### *Business*

Local firms would benefit from the economic activity related to the installation and operation of wind turbines.

- Ohio's manufacturing industry could benefit from the wind power industry.

  Manufacturing remains significant to the region's economy. However, recent decades have brought a change in demand for many of the products traditionally manufactured here. For example, raw steel production in Ohio peaked in 1973, when 26.5 million tons were produced. In 2001, only 15.7 million tons were produced, less than 60 percent of the steel produced during the industry's heyday. One way to revitalize manufacturing would be to encourage its transition to the production of products for innovative industries such as wind power, which is expected to experience high growth in the coming decades. Some existing companies in the area already manufacture components for the wind power industry, and others could join this growing sector. The market is expected to be large: the U.S. Department of Energy aims to more than double the installed capacity of wind generation in the United States, to 10,000 megawatts, by 2010. The Electric Power Research Institute's (EPRI) estimate is more aggressive—nearly 12,000 megawatts installed in the United States by the end of 2006.

## Benefits (continued)

### *Community*

A revitalized and modernized manufacturing industry could enhance the area's image, which could help develop the tourism industry. An array of wind turbines along Ohio's coast would be a highly visible testament to the region's interest in moving away from its polluted past while remaining true to its core competencies.

### *Environment*

Nearly 90 percent of all Ohio electricity is generated by burning coal, which results in substantial emissions of pollutants such as the greenhouse gas carbon dioxide. Installing wind power would reduce these emissions or keep them constant as the region's consumption of electricity grows.

## Why Wind Power will work in Cuyahoga County

Wind power is a mature, proven technology, with nearly 25,000 megawatts of installed capacity worldwide as of 2001. The Ohio Department of Development is completing a new wind map for Ohio, which shows that parts of the state, notably coastal and offshore areas, are well suited for wind power.[1] The City of Bowling Green recently installed two 1.8 megawatt turbines, Ohio's first. They are expected to generate 6,900 megawatt hours of electricity annually, enough for roughly 100 homes.

[1] Onshore areas near the edge of Lake Erie are estimated to have Class 3 wind, while offshore areas range from Class 4 (nearest to the shore) to Class 6 in areas further from shore. Given current capital and installation costs, areas with Class 3 winds and stronger are considered to be economically viable sites for wind turbines.

## Barriers

Despite being cleaner than any fossil fuel-based power plant, wind turbines still elicit NIMBY ("not in my backyard") responses. Property owners near potential onshore and offshore wind-power sites often oppose projects, citing compromised views and lowered property values.

Offshore turbines face several additional siting issues. For example, one technical concern is that a large set of wind turbines has never been constructed in a fresh water setting. Fresh water freezes at a higher temperature than salt water, and the effects on turbines are not fully understood. Also, concern has been expressed that, because the bottom of Lake Erie varies greatly in depth, installation costs could increase. In 2003, Governor Taft signed an executive order banning drilling for natural gas in Lake Erie. It is possible that attempts to license the installation of wind turbines in the Lake could be challenged based on this ban. For these reasons, onshore wind turbines may be more feasible than offshore in the near-term, with the latter becoming more feasible later, as technology, and experience reduce the aforementioned barriers.

Finally, the state of the electricity-transmission infrastructure that connects the areas where the best wind resources exist (the shore of the lake and off the shore) to the greater electric grid could significantly change the feasibility of such a project. That is, large wires are needed to transmit electricity generated in these areas to industry and population centers miles away. Therefore whoever pays for the wind turbines may be required to pay to upgrade transmission lines, which could render the project economically infeasible. Fortunately, early indications are that sufficient transmission capacity exists, but further attention should be paid to this issue.

## Implementation strategies

### *Regulations and Incentives*

Introduce regulations or incentives at the State and municipal levels to increase the amount of energy that is generated from renewable sources. Incentives could include rebates or tax breaks for investments in renewable energy technologies. Regulations could include increased restrictions or taxes on the emissions from fossil-fuel-based power plants.

### *Consumer Choice Program*

Ohio's community choice aggregation law allows municipalities to form community-wide buyers' cooperatives to purchase electric power, in order to ensure favorable rates. This law could allow electricity users in Ohio who are willing to pay a premium for electricity generated from renewable sources to do so. By specifically allowing this type of "opt-in" program, significant demand for renewable energy could materialize.

## Next steps

### *Survey transmission line capacity*

Survey transmission capacity as part of a larger-scale study (e.g., Energy-Resource Investment Strategy (see p. 59). The survey should include areas outside the Cuyahoga Valley, such as areas near Lake Erie.

### *Renewable portfolio standard*

Create a statewide renewable portfolio standard (RPS) requiring every power producer in the state to invest in renewable energy, which could include wind projects.

### *Green pricing program*

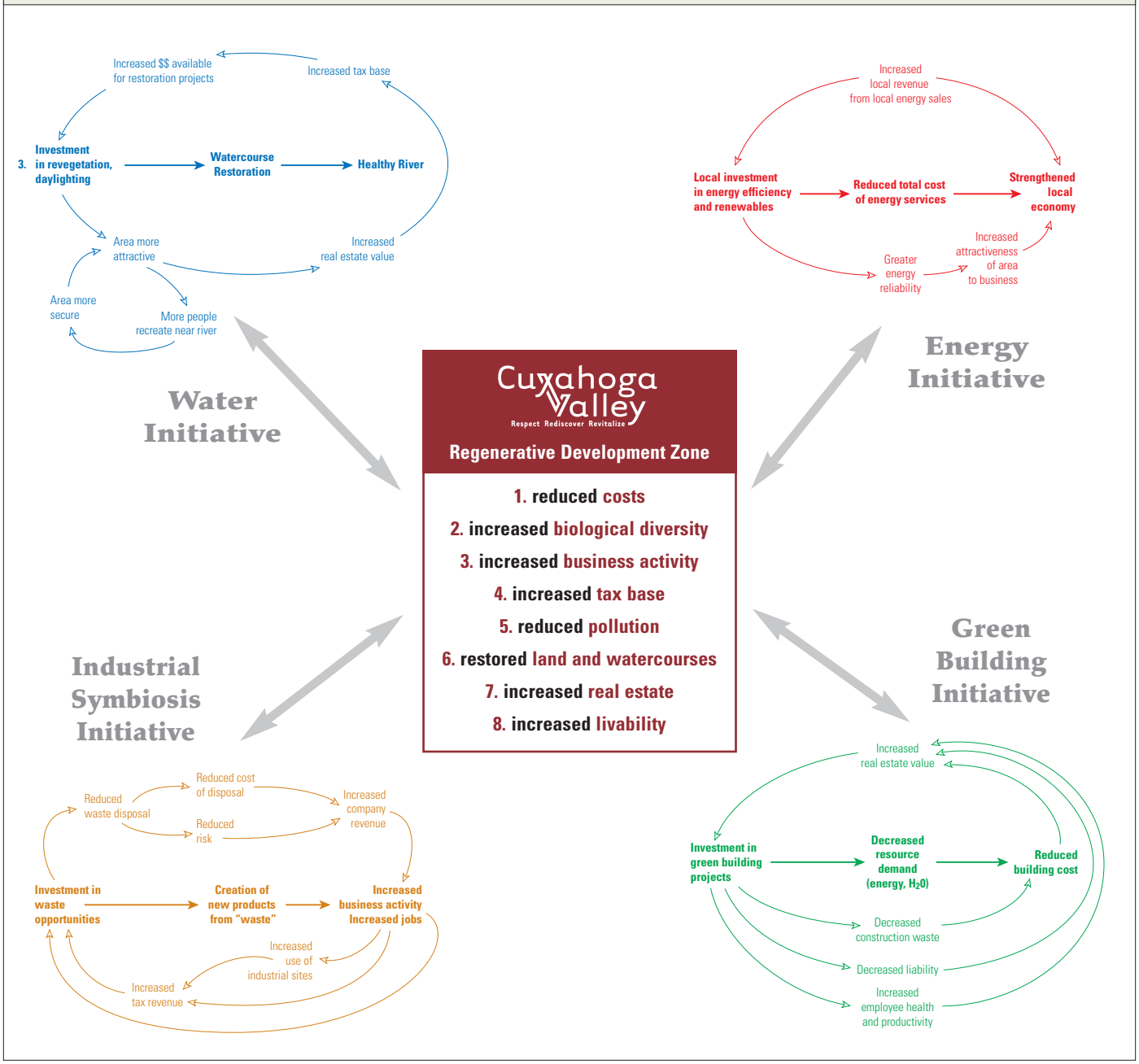
Promote wind power by creating a "green pricing program," which gives consumers the option to purchase electricity from a provider whose power mix contains a designated percentage of renewable energy. The provider can either install the renewable technologies or purchase "green tags" from another firm. Green tags are certificates that represent the added benefits and costs of renewable energy. Individual municipalities could encourage providers to offer green pricing by agreeing to buy power for their facilities from such a provider.

# Cuyahoga Valley Integrated Solutions

This final diagram illustrates how integrated solutions magnify benefits, creating more value that can help pay for additional integrated solutions, which create even more value, and so on. In various colors, it depicts the four smaller diagrams from various sections of the report: industrial symbiosis in orange, restored watercourses in blue, green building in green, and energy in red. Each of these four diagrams depict initiatives from the four areas.

The gray connecting arrows demonstrate how initiatives are integrated and reinforce each other.

Note that, though this diagram illustrates the concept of integrated solutions and the magnified benefits that flow from them, it is far from complete. It omits many factors and includes diagrams from only four of the ten sets of recommendations in this report. A complete diagram would be quite complex and require much more space.




BP Oil Pipeline

# Appendices

# Appendix 1:
# Natural Capitalism

The Industrial Revolution made people vastly more productive when low per-capita output and a relative scarcity of people were limiting progress in exploiting a seemingly boundless natural world. Today we face a different pattern of scarcity: abundant people and laborsaving machines, but diminishing natural capital.

Natural capital refers to the earth's natural resources and the ecological systems that provide vital life-support services to society and all living things. These services are of immense economic value; many are literally priceless, since they have no known substitutes. Yet current business practices and public policies typically ignore their value. As a result, natural capital is being degraded and liquidated by the wasteful use of energy, materials, water, fiber, topsoil, and ecosystems.

The next Industrial Revolution, already emerging, is a response to the changing pattern of scarcity. It will transform industrial processes and business practices to economize on what is now the limiting factor of production: natural capital. Our experience shows that firms typically enjoy increased profit and distinct competitive advantages by doing business as if natural capital were properly valued, even when (as now) it is valued at zero.

## The Four Principles of Natural Capitalism

Natural Capitalism is a new business model that synergizes four major elements:

1. **Radically increase the productivity of resource use**. Through fundamental changes in production design and technology, leading organizations are making natural resources stretch 5, 10, even 100 times further than before. The resulting savings in operational costs, capital, and time quickly pay for themselves, and in many cases initial capital investments actually decrease.

2. **Shift to biologically inspired production** ( Biomimicry ) with closed loops, no waste, and no toxicity. Natural Capitalism seeks not merely to reduce waste but also to eliminate the concept altogether. Closed-loop production systems, modeled on nature's designs, return every output harmlessly to the ecosystem or create valuable inputs for other manufacturing processes. Industrial processes that emulate nature's benign chemistry reduce dependence on nonrenewable inputs, eliminate waste and toxicity, and often allow more efficient production.

3. **Shift the business model away from the making and selling of "things" to providing the service that the "thing" delivers.** The business model of traditional manufacturing rests on the sporadic sale of goods. The Natural Capitalism model delivers value as a continuous flow of services—leasing an illumination service, for example, rather than selling light bulbs. This shift rewards both provider and consumer for delivering the desired service in ever cheaper, more efficient, and more durable ways. It also reduces inventory and revenue fluctuations and other risks.

4. **Reinvest in natural and human capital**. Any good capitalist reinvests in productive capital. Businesses are finding an exciting range of new cost-effective ways to restore and expand the natural capital directly required for operations and indirectly required to sustain the supply system and customer base.

Innovative organizations are already prospering from these four principles. Their leaders and employees are also feeling better about what they do: eliminating unproductive tons, gallons, and kilowatt-hours makes it possible to invest in human capital—the people who foster the innovation that drives future success.

These ideas are fully developed in *Natural Capitalism: Creating the Next Industrial Revolution*, Little Brown, 1999, co-authored (with Paul Hawken and Hunter Lovins) by Rocky Mountain Institute CEO Amory B. Lovins. The complete book can be found at www.natcap.org.

Appendix 2:

# Regenerative Development Zone

Biological Wastewater Ecosystems refers to technologies that clean water by replicating natural ecosystems in a controlled environment, and by using only the sun for energy. Ocean Ark International is perhaps the leader in this field and for over a decade the organization has been developing floating ecological technologies (called Restorers or EcoMachines) to purify wastewater, maintain pond health or restore stressed natural bodies.
http://www.oceanarks.org/restorer/

Cuyahoga County's Greenspace Plan
http://planning.co.cuyahoga.oh.us/green/greenprint.html.

Green Infrastructure Database: Chicago Openlands Project (*OLP*) and the Center for Neighborhood Technology (*CNT*) have a database of the region's green infrastructure: the interconnected network of open spaces and natural areas that provides wildlife habitat and recreational opportunities. CNT's goal is to encourage natural resource protection and land preservation across several states through the creation of an easy-to-use, interactive database. Visit www.cnt.org

## Brownfield Redevelopment

**EPA Brownfields Initiative:** The Green Buildings on Brownfields Initiative is an EPA program designed to promote the use of green building techniques at brownfield properties in conjunction with assessment and cleanup. Through several pilot projects, the EPA is providing communities with technical assistance to facilitate the development of green buildings on their brownfields. Building environmentally friendly buildings on what was once contaminated land can be symbolic of a new, environmentally sound direction for communities, as well as tangible growth for their economies.

- Green Buildings on Brownfields Initiative: Pilot Projects Publication Number: EPA-500-F-02-141 [HTML (27K) | PDF (140K) 3 pages] October 2002. www.epa.gov/brownfields/
- EPA's Green Buildings program: www.epa.gov/greenbuilding/

## Examples of Regeneration of Industrial Areas

Ruhr Redevelopment, Germany. Stretching roughly 140 miles through North Rhine-Westphalia, the Ruhr River Valley is a heavy-industry corridor. At its height in the middle of the last century, the region was, in effect, a giant integrated-metal-processing machine, dominated by coalmines as well as coke, iron, and steel plants, and the railroads and autobahns that linked them.

In 1989, the Westphalian government chartered an organization called the IBA, a flexible, independent planning corporation, to transform the Ruhr's image with innovative architectural and cultural projects. IBA's first major initiative was a park on the grounds of an old steel mill in the northern part of the city of Duisburg. The IBA vision is to create a new high-quality urban area, and regenerate the natural landscape along the Emscher River between Duisburg and Dortmund, an area of 800sq km. This huge reclamation project (of over 100 projects) is in the former Ruhr coal and steel-producing region that has high levels of pollution. Projects range from restoration of watercourses to building new houses, business parks, and research centers. www.epa.gov/swerosps/bf/html-doc/emscher.htm or www. metropolis.com

Vancouver BC: Vancouver is a success story for long-term city planning and brownfield redevelopment. Local leaders have refused to bisect the city with freeways and have maintained public access to the waterfront, similar to CVI ideas. These planning measures along with their new growth and environmental policy (Port 2010), which was enacted in 1994, have helped

Vancouver to strengthen its economy without sacrificing the environment. Its website features 23 individual neighborhoods. www.city.vancouver.bc.ca/community_profiles/CommunityList.htm

One Vancouver neighborhood of particular relevance to the Cuyahoga Valley, **Granville Island** was strictly an industrial area until it was transformed by creative public and private, residential and commercial development into an exciting arts, entertainment, and tourism area in which the industrial past in celebrated in the design of new and renovated buildings. Several industries remain operational, flanked by trendy restaurants, interesting shops, artists' studios, and a renowned arts school.
www.granvilleisland.com/en/about/development

Southeast Granville Slopes Neighborhood

Pittsburgh's three rivers (Allegheny, Monongahela and Ohio) were a key factor in creating America's largest inland port, just as they are key to the city's continued vitality. Following a new city plan in 1989, Pittsburgh acquired substantial riverfront property. According to its website, "Pittsburgh is committed to capitalize on its greatest asset by adding the value that good design, thoughtful land use and public access bring to development. A riverfront divided, parcel by parcel, ignores the enormous development potential of a single, unifying riverfront greenway. Thus, a push for continuous public access is a call for the full development of the city's most important natural and economic resource." www.city.pittsburgh.pa.us/downloads/documents/river2.pdf

Most of Pittsburgh's steel mills occupied prime property because they are located on the water to access transportation. In an attempt to regenerate the city's river areas, the sites of several former steel mills have been re-developed. One example is a former industrial dump, the 240 acre Nine Mile Run, which was acquired by Pittsburgh Urban Renewal Authority. Written in 1999 by Rocky Mountain Institute, *Re-evaluating Storm water: The Nine Mile Run Model for Restorative Development* portrays natural storm water management that can reduce sewer overflows, restore urban watersheds, and revitalize communities. www.rmi.org/sitepages/pid277.php.

Boston MA: The most effective brownfield redevelopments involved not only design professional, but also citizens, who then had ownership over the final design. Rather than presenting final designs, experts presented design ideas and lead discussions.
www.unhabitat.org/register/item.asp?ID=1022

Fitchburg, MA: Riverfront Park is a reclaimed rubber-plant site and a good model for the Regenerative Development Zone idea. An EPA website includes photos documenting progress on the site over time.
http://www.epa.gov/region1/brownfields/success/fitchburg_hrf_agp.htm

# Appendix 3:
# Industrial Symbiosis

This appendix explores four examples of industrial symbiosis. The three examples from North America are described briefly. The Danish example is explored in more detail and well worth careful scrutiny. Its example answers many frequently asked questions about this intriguing phenomenon. It reveals that this remarkable idea may prove practical and profitable in such a resource-rich place as the Cuyahoga Valley.

## North America — New Jersey, Texas, and Alberta

The US Business Council for Sustainable Development (BCSD) is the organization behind several successful examples of industrial symbiosis in North America. The US BCSD uses the term "by-product synergy" to describe the process of matching under-valued waste (or by-product) streams with potential users and creating new revenue or savings for the organizations involved.

In particular cases, the US BCSD has sought the support of the US EPA and examined ways to change regulations that block companies from developing environmentally beneficial symbiotic activities. In New Jersey for example, the EPA and state regulators are working as part of a synergy review team and documenting solid waste, energy and air emission implications associated with industrial reuse of by-products.

The following is a brief overview of several projects led by the US BCSD. For further information and case studies refer to their website.

### 1. New Jersey

Begun in February 2002, the New Jersey project involves 15 facilities owned by such companies as Dow Chemical, Mannington Mills, Public Service Enterprise Group, Burlington County Recovery Complex, NJ American Water and OTC-Burlington County. Also, the EPA is using the New Jersey project as a pilot to understand and measure benefits from the BPS process, and are funding a non-governmental organization, the Center for Clean Air Policy, to carry out the research.

The facilities have explored more than 50 possible synergies, and approximately 12 are being pursued by participating companies. For example, Dow Chemical is exploring the use of 'white water' a wastewater stream that is a by-product from the production of latex for paints. White water is generally transported to a treatment plant, but alternative uses such as a dust control in road construction and agricultural operations are being considered.

Also, Dow currently uses waste cuttings generated in the production of rigid polyurethane foam boards, for use as a building insulation. Approximately 5% of the foam board is lost when cut down to size. The foam scraps can be shredded and added to potting soil to increase aeration

### 2. Texas

In the early 1990s, management of Chaparral Steel investigated synergies between the steel company and the operations of its parent company Texas Industries, a manufacturer of Portland Cement. The most successful synergy discovered was the use of steel slag as a raw material for cement. The steel slag contained calcined lime formed by the high temperatures of the steelmaking process and also a primary resource for Portland cement. By using the steel slag instead of purchased lime, which would be heated to calcinations, Texas Industries reduced the energy requirements and related emissions ($CO_2$, $NO_x$, $SO_2$) from the cement making process. Profits for both companies increased and the technology, CemStar, has been patented.

3. Alberta

The project was initiated in February 1999. It involved 16 corporate and research participants including Petro-Canada, Shell Canada, Air Liquide, Alberta's Industrial Heartland Association, Alberta Science and Research Authority and Wascana Energy Inc. The focus of the project was to ensure that the natural resource-based economy remained competitive and productive.

Initial synergistic opportunities arose between the Weyerhaeuser Kraft Mill and a Husky refinery. It was found that spent caustic (NaOH with contaminants) from the refinery could potentially be used in the Kraft process. The idea was tested and implemented in 2000. Instead of transporting spent caustic to injection sites, the material was sent directly to the Mill plant with an estimated saving of $300,000 per year for the two companies.

A total of 25 possible opportunities were selected by the participants and pursued under five main classifications: energy, inorganics, sulphur and high-sulphur coke, industrial gases and eco-industrial parks. A full analysis of this project is available from the engineering consultants involved in the project at www.hatch.ca

## Denmark — Kalundborg

Kalundborg is an industrial zone on the coast of Denmark that is perhaps the most celebrated and studied example of industrial symbiosis. It evolved over the course of decades through a series of partnerships between various companies. In almost every case, the companies sought to reduce their costs and make money by finding uses for their "waste" products.

The Kalundborg industrial ecosystem in Denmark comprises six core partners:

- Asnæs Power Station is Denmark's largest power station (coal-fired, 1,500 megawatts capacity)
- Statoil Refinery is Denmark's largest refinery with a capacity of 3.2 million tons per year (recently increasing to 4.8 million tons per year)
- Gyproc is a plasterboard factory making 14 million square meters of gypsum wallboard annually
- Novo Nordisk is an international biotechnological company with annual sales over CA$2.6 Billion. The plant produces industrial enzymes and pharmaceuticals (including 40% of the world's supply of insulin)
- The City of Kalundborg supplies district heating to 20,000 residents, as well as water to homes and industries
- A/S Bioteknisk Jordrens specializes in soil remediation. Sewage sludge provides the nutritional matter for this process, which cleans roughly 500,000 tons of soil annually.

How Did It Start?

Kalundborg's industrial symbiosis did not the result from a plan by some farsighted leader. Rather, it was the result of several distinct bilateral deals between companies seeking to reduce waste-treatment and disposal costs, and to gain access to cheaper materials and energy, while generating income from production residues. Each relationship resulted from a normal two-party negotiation. Ideas sometimes took years to become formal arrangements[1].

*Several relationships began the series of connections:*

1. In 1961, in order to conserve groundwater supply, a project was initiated to use surface water from Lake Tissø for a new oil refinery. The city of Kalundborg took the responsibility for building the pipeline while the refinery financed it.
2. In 1972, Gyproc located its facility to Kalundborg to take advantage of low-cost fuel-gas available from Statoil. Previously, the Statoil refinery had been flaring its excess gas.

[1] http://www.rps.psu.edu/0205/economics.html

3. In 1981, the municipality of Kalundborg eliminated the use of 3500 oil-fired residential furnaces by distributing heat from the power plant through a network of underground pipes. Homeowners pay for the piping, and receive cheap, reliable heat in return.

Kalundborg Chronology:[2]

| | |
|---|---|
| 1959 | Asnæs Power Station commissioned |
| 1961 | Statoil Refinery commissioned; water piped from Tissø Lake |
| 1972 | Gyproc A/S established; excess gas is piped from Statoil Refinery |
| 1973 | Asnæs Power Station draws water from Tissø Lake through a pipeline after expansion |
| 1976 | Novo Nordisk starts delivery of sludge by trucks to farmersfor fertilizer |
| 1979 | Asnæs Power Station starts to supply fly ash to cement producers, including Aalborg Portland |
| 1981 | Asnæs Power Station produces heating for the municipality of Kalundborg |
| 1982 | Asnæs delivers process steam to Statoil and Novo Nordisk |
| 1990 | After installing a desulphurization plant, Statoil Refinery starts delivery of a hot liquid sulfur byproduct to Kemira (a sulphuric acid producer in Jutland) |
| 1991 | Statoil delivers treated waste water to Asnæs power plant to meet various water consumption needs |
| 1992 | Following desulphurization, Statoil's surplus refinery gas becomes clean enough for Asnæs Power Station, replacing some of the station's coal use. |
| 1993 | Asnæs sells the byproduct calcium sulfate (gypsum) from its desulphurization process to Gyproc |
| 1995 | Asnæs constructs a re-use basin to capture water flows for internal use and to reduce dependency on Lake Tissø |
| 1997 | Asnæs switches half its capacity from coal to orimulsion; begins to send out fly ash from vanadium/nickel recovery |
| 1999 | A/S Bioteknisk Jordrens uses sewage sludge from the municipality of Kalundborg as a bioremediation nutrient for contaminated soil |

Other waste exchanges that emerged during this period:

- Asnaes Power Station now draws some of its cooling water from the fjords, lessening dependence on Tissø Lake. The hot salt-water byproduct is used by a local fish farm.
- The fish farm's water treatment plant produces sludge, which is used as an agricultural fertilizer for farmers.
- Surplus yeast from insulin production at Novo Nordisk goes to farmers as pig food.

Some Economic and Environmental Outcomes:

Net annual savings are estimated to be between $12 million and $15 million. Financial gain is estimated at $16.8 million per year, on an overall investment of $84.1 million[3].

*Annual savings through interchanges at Kalundborg[4]:*

Water savings

- Statoil: 1.2 million cubic meters
- Asnæs: total consumption reduction 60%

2 'Industrial Symbiosis: The Legacy of Kalundborg' John Ehrenfield, Marion Chertow in R. Ayres and L Ayres Handbook of Industrial Ecology Edward Elgar Publishing 2002
Industrial Ecosystems: Developing Sustainable Industrial Structures
By Nicholas Gertler http://www.sustainable.doe.gov/business/ng_chp2.shtml
3 http://www.statoil.com
4 'Industrial Symbiosis: The Legacy of Kalundborg' John Ehrenfield, Marion Chertow in R. Ayres and L Ayres Handbook of Industrial Ecology Edward Elgar Publishing 2002

Fuel savings
- Asnæs: 30,000 tons of fossil fuel saved by using Statoil fuel gas
- Community heating via steam from Asnæs

Input chemicals/products
- Fertilizer equivalent to Novo Nordisk sludge (about 1300 tons nitrogen and 550 tons phosphorous)
- 97,000 cubic meters of solid biomass (NovoGro 30)
- 280,000 cubic meters of liquid biomass (NovoGro)
- Commercial fertilizers of 20,000 hectares of farmland using Statoil sulfur
- 170,000 tons of gypsum
- Recovered vanadium and nickel

*Wastes turned into usable goods through interchanges*
- 50,000 – 70,000 tons fly ash from Asnæs
- Scrubber sludge from Asnæs
- 2800 tons sulfur as hydrogen sulfide in flue gas from Statoil (air)
- water treatment sludge from Novo Nordisk (landfill or sea)
- 380 tons of sulfur dioxide avoided by replacing coal and oil (air)

What Were the Incentives?[5]

**Financial:** Initial links between the companies tended to involve the sale of waste products without any significant pretreatment. This pattern includes the initial sale of Statoil's flue gas, Asnæs' sale of fly ash, clinker, waste heat and process steam, as well as the use of cooling water to heat fish farm ponds. These arrangements were based on a re-routing of what used to be waste, without the need to alter the byproduct to any significant extent.

**Regulatory:** Links over the last seven years or so have tended to be dependent upon the application of pollution control technologies. These links, which comprise just over half of the symbiotic arrangements, do not simply move regular process byproducts around, but alter the processes and disposal practices to make them more environmentally benign. For example, scrubbing for $SO_2$ by the power plant and desulphurization at the refinery conditioned the waste stream to turn what used to be pollution into fuel gas, sulfur, and gypsum.

**Community** General water scarcity, plus community and regulatory pressure to eliminate thermal pollution of the fjord, was a major impetus for the power station's use of the oil refinery's cooling water. Changes in regulations regarding water pollution rendered the treatment and distribution of Novo Nordisk's sludge the least-cost disposal alternative. Pressure to alleviate water pollution compelled the refinery to invest in a wastewater treatment facility, which now cleans the water clean enough to be re-used by the power plant.

Whose Idea Was It?

Valdemar Christensen, a product manager at the Asnæs Power Station, coined the term "industrial symbiosis" and emerged as an architect of its evolution in Kalundborg. Several characteristics of this phenomenon have emerged:
- Companies did not act on their own regarding opportunities outside their core business.
- They tended to act irrespective of environmental benefit or government intervention.
- Though each company considers the others when making decisions, each evaluates its own agreements independently.
- There is no Kalundborg-wide assessment of performance because participating companies believe that this would be a complex and unrewarding standard[6].

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**5Industrial Ecosystems: Developing Sustainable Industrial Structures**
**By Nicholas Gertler** http://www.sustainable.doe.gov/business/ng_chp2.shtml

[6] Industrial Ecosystems: Developing Sustainable Industrial Structures
By Nicholas Gertler http://www.sustainable.doe.gov/business/ng_chp2.shtml

Information Exchange:

An important aspect of Kalundborg is that industrial engineers and managers live together in a small community and interact regularly. The resulting exchange of technical information that occurred naturally may not occur in a large city without purposeful intervention by some third-party convener.

Basic requirements for a symbiotic relationship:

- Participants must complement each other but be different
- They must produce large and continuous flows of waste/by-products
- Projects must be commercially viable
- Participants must be geographically close
- The mental distance between them must also be small

Barriers and Opposition:

According to Christensen, no one opposed linkage decisions because they earned money and thus were like any other business decision. Each company has its own economic interest in mind: negotiations are reportedly intense and just like those for any other business deals.

However, some Kalundborg locals initially opposed the city's requirement that all residents replace their individual oil furnaces with piping necessary for district heating, which uses hot water from the power plant's excess heat. But they have since acquiesced[7].

Managing the risks of interdependency[8]

Several factors could make the types of waste exchange described above risky for the companies involved, in particular, the potential for:

- Supply disruptions;
- Limits on one participant's scale of operation as a result of symbiotic contracts; and
- Changes in the profitability of the symbiotic relationships.?

Regarding each of these factors:

*Disruptions*: The system has proven fairly robust. Examples include:

- Gyproc receives gas from Statoil. The gas is so light that it cannot be easily liquefied. Therefore, Gyproc uses it as a continuous flow from the refinery. To cope with any disruptions in the flow of gas from the refinery, Gyproc has a large butane tank that serves as backup. Also, Statoil informs Gyproc of any pending reductions or cessations in gas flows.
- Gyproc gets its gypsum (its main raw material) from the scrubbers of Asnæs and another power plant. This material is easily stockpiled. Furthermore, Gyproc buys mined gypsum because it uses a mixture of the two. Asnæs supplies could easily be replaced by virgin material or material from another power plant.
- Novo Nordisk relies on Asnæs for all its steam needs. If Asnæs decided to buy electricity from hydro power plants, it would still have to run some boilers to meet its contractual steam supply obligations to Novo Nordisk. The price of steam to Novo and Statoil includes a premium as insurance against this possibility.

*Scale*: Within a reasonable range of variation, symbiotic relationships have not limited the participant's ability to alter the scale of their operations. For example:

- Statoil is expanding its capacity and will produce more gas and use more cooling water and process water. The excess gas is expected to be burned by Asnæs in place of coal.

[7] Industrial Ecosystems: Developing Sustainable Industrial Structures
By Nicholas Gertler http://www.sustainable.doe.gov/business/ng_chp2.shtml
[8] Industrial Ecosystems: Developing Sustainable Industrial Structures
By Nicholas Gertler http://www.sustainable.doe.gov/business/ng_chp2.shtml

- Novo Nordisk must be able to dispose of its sludge by applying it on farmland. It has built a 70 km pipeline network (with plans to expand) and also uses a large number of tanker trucks. Expansion of production could be limited by an inability to dispose of all the sludge, but such an eventually seems unlikely.

*Economic viability:* The market price of alternative and virgin material is consistently higher than the cost of symbiotic arrangements. Each link has either makes economic use of a byproduct or represents a low cost mechanism for compliance with environmental regulations. For example, the elaborate infrastructure that Novo Nordisk built to convert its by-products to fertilizer and distribute to local farmers was the least-cost way to comply with regulations.

What Role Did Government Play?

Though the local council encouraged the symbiosis, all the arrangements have been established at the initiative of the companies themselves and on the basis of commercial assessments[9]. That said, regulation inspired linkages and compelled the use of pollution-control technologies that made some of the linkages possible. According to Valdemar Christensen, economics alone generates a certain amount of symbiosis, at least the low-hanging fruit, but some symbiotic arrangements require the impetus of government action, for example, pollution-controls and price adjustments.

For example, Danish power plants were recently required to decrease aggregate $SO_2$ emissions. Decisions regarding how to distribute the emission reductions was left to the industry. Though, not all power plants built scrubbers, Asnæs did because it could sell the scrubber by-product to Gyproc.

In addition, the flexibility of the Danish regulatory framework made possible arrangements that might have been prohibited in North America. For example, the flue gas that Statoil pipes to Gyproc and the liquid sulfur that Statoil sells to Kemira probably would not have been approved in North America because both substances would be classified as "hazardous waste." Furthermore, the new resources created from these by-products would also have been treated as hazardous under the United States' "mixture and derive from" rule, which classifies as "waste" new products that incorporate industrial waste[10].

*The Asnaes Power Station is the hub of the network of materials and energy by-product exchanges at Kalundborg. The Statoil refinery is to the North, beyond the stacks. Novo Nordisk and Gyproc plants are about a kilometer to the South.*

(diagram on next page)

[9] http://www.statoil.com
[10] http://www.iedm.org/library/art148_en.html

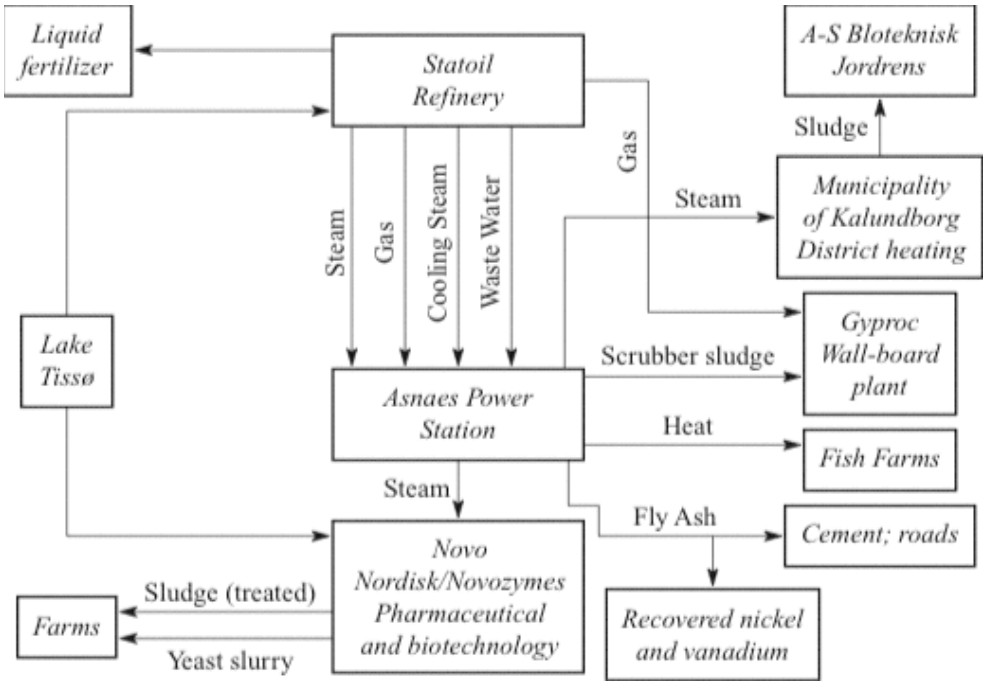


Diagram: Industrial symbiosis at Kalundborg, Denmark[11]

[11] 'Industrial Symbiosis: The Legacy of Kalundborg' John Ehrenfield, Marion Chertow in R. Ayres and L Ayres Handbook of Industrial Ecology Edward Elgar Publishing 2002

# Appendix 4:
# **Whole-System Inventory of Cuyahoga Industries**
## A Beginning

The table below is the start of a detailed inventory of potential industrial symbiosis in the Cuyahoga Valley or in a newly established Cuyahoga Regenerative Development Zone. The inventory would point to rewarding symbiotic arrangements. It would identify:

1. Waste and by-products of certain businesses that could be used as inputs to others, and
2. Opportunities for utility and resource collaboration among similar operations.

The table illustrates the concept only; it does not represent all the transactions occurring at the organizations displayed, nor does it include all possible organizations. However, it does include a few operations and types of industries that do not now exist, but which might be attracted to an innovative Cuyahoga Regenerative Development Zone.

| Industry | Inputs | Process | Outputs | Notes |
|---|---|---|---|---|
| **Zaclon (Chemical Manufacturing)** | Secondary zinc, natural gas for boilers | Produces zinc chloride, galvanizing fluxes, ammonium chloride, sodium bisulfate, and potassium silicates | Mud from process 20% solids, iron, zinc, potassium silicate, heavy metals, lead, cadmium | 35-50 trucks per year |
| **Air Products** | Dry air (78% nitrogen, 21% oxygen, 1% argon, natural gas, electricity | Compression, distillation and cooling - Air separation which will yield excess heat | Hydrogen, Argon, nitrogen, Oxygen | The cost of power is a significant expense |
| **Aggregate** | Drilling and extraction equipment, truck transportation | Mining, extraction and processing of materials | Ground materials – grinding could also be used for ceramics? | |
| **ISG** | Limestone, coke, iron ore, oxygen, water | Continuous cast steel, secondary processing, treat and recycle water during steel production | Slag, waste heat, steam, carbon monoxide, EAF dust | EAF dust contains recoverable zinc oxide. There is an on-site landfill – primarily disposal of iron oxide, waste water treatment sludge and filter medium – may be capped 3-4 years |
| **Fuel Cell Manufacturing** | Biomass, natural gas,<br>Specialty ceramic materials (which require heat) | | | NETL and the Strategic Center for Natural Gas through the Dept of Energy's Office of Fossil Energy has supported development of solid oxide fuel cells for large-scale stationary power applications. |
| **Recovery and Environmental Services (e.g., GEM)** | Industrial waste water and other industrial waste materials | Process waste to separate hydrocarbons and recover valuable materials | Mid-range recovered fuel (boiler and furnace applications) | Remediation, emergency response, hazardous material handling |

| Industry | Inputs | Process | Outputs | Notes |
|---|---|---|---|---|
| **Secondary Steel Processing (galvanizing, pickling)** | Steel, heat, various chemical treats | | | Waste acid, waste zinc |
| **Cement** | Steel slag | | Carbon dioxide, waste heat | |
| **Asphalt** | Aggregate, emulsions, heat | | | |
| **Gasification** | Electricity, industrial and municipal waste | | Energy | May avoid the need for industrial land-filling |
| **Bio-remediation Industry** | Contaminated soils | | Clean Soils, clean brownfields, revitalized vegetation | Possible matches with compost, food waste, mushroom industries. |
| **Living Water Machines** | Municipal and industrial waste water | Use of staged tanks with various biological treatments to treat waste water. | Clean water, greening the landscape | May replace need for waste water treatment depending on volume of water treated. Tank production exists in Cleveland |
| **Aquafarming** | Clean water, fish, fish food, heat, electricity, oxygen | Use of indoor tanks and controlled conditions to farm raise fish | Mature fish, fish waste, waste water, 75degree Co2 rich air | Maingate has relationships with sources of inputs and outputs. H20hio may be interested |

# Appendix 5:
# Green Building Resources

**Cleveland Green Building Coalition**
3500 Lorain Avenue, Suite 200
Cleveland, Ohio 44113
(216) 961-8850

**EcoCity Cleveland**
3500 Lorain Avenue, Suite 301,
Cleveland OH 44113
(216) 961-5020
www.ecocitycleveland.org (see Citizen's Bioregional Plan for NE Ohio." 2000)

**Community Viz.** A tool designed for planning consultants and municipal planners to simulate development decisions, create the predicted long-term effects of each, and take a virtual walk through of the resulting development. The software's outputs include solutions for: land use and zoning, parks and recreation management, neighborhood planning, redevelopment strategies, wildfire risk assessment, forest management plans, habitat fragmentation evaluation, land evaluation and suitability analysis, and environmental visioning. (303) 442-8800 or info@communityviz.com

**Environmental Building News**. This monthly newsletter is full of clear, concise information on environmental design and construction. Also available *Product Catalog: Green Building* resource, and searchable CD-ROM of past issues. Environmental Building News, 28 Birge Street, Brattleboro, VT 05301, (802) 257-7300; www.buildinggreen.com

**Green Building Advisor CD-ROM.** BuildingGreen, Inc. An interactive CD-ROM for Windows and the Macintosh featuring specific design strategies that can improve the environmental performance, cost-effectiveness, and healthiness of a building and its site, from pre-design through to occupancy. This tool draws from a database of over 700 green building checklists. Each strategy links to a detailed explanation, in-depth case studies and sources of further information. Updated in 2001. (800) 861-0954, www.BuildingGreen.com

**Green Development: Integrating Ecology and Real Estate.** Rocky Mountain Institute: Alex Wilson, Jenifer L. Seal (Uncapher,) Lisa McManigal, L. Hunter Lovins, Maureen Cureton, William D. Browning. New York, NY: John Wiley & Sons, Inc., 1998. If you're a developer, architect, planner, contractor, lender, or city official, this book speaks your language. Every stage of the development process is examined in detail: market research, site planning, design, approvals, financing, construction, marketing, and occupancy. Also included are lists of project vital statistics and contacts, books and other information sources, and development strategies. *Green Development* is based on 80 case studies drawn from Rocky Mountain Institute's extensive worldwide research and consulting work. From these real-world experiences, it distills proven procedures, potential pitfalls, and practical lessons that will help shorten the learning curve on the path to environmentally sound, community-supportive, and financially rewarding real estate development. www.rmi.org

**Green Developments 2.0 CD-ROM**. RMI 2002. Version 2.0, a companion to the *Green Development* book, features expanded information on each project as well as a larger screen display, added images, updated resources, and weblinks. The CD-ROM serves as an excellent resource to a wide variety of design professionals (including architects, engineers, and designers), community leaders, and real-estate financiers. This new version contains more than 200 case studies of green buildings and projects from around the world. The resource describes an exciting field of creating fundamentally better buildings and communities- more comfortable, more efficient, more appealing, and ultimately more profitable. Green Developments 2.0 was developed in cooperation with and funded by the United States Department of Energy and the Kettering Family Foundation. Additional funding was provided by the United States Environmental Protection Agency. Produced for Rocky Mountain Institute by Sunnywood Designs. www.rmi.org

**Ecological Architecture: Bioclimatic Trends and Landscape Architecture in the Year 2001**. King, Julie ed. New York, NY: Loft Publications, 2001. This book describes recent projects from around the globe that have effectively incorporated energy-saving devices and ecological principles into building design. Great photography that captures the essence of daylighting.

**LEED Green Building Rating System**. Washington, DC: US Green Building Council. Extensive background information and guidance for meeting the requirements of the USGBS's rating system for commercial buildings. Lists the intent, requirements, submittals, and technologies/strategies for each credit, and also includes the LEED checklist. www.usgbc.org.

# Appendix 6:
# Water

This appendix enumerates the benefits of daylighting streams, discusses how conventional thinking about storm water is changing, describes the challenges of urban runoff, and includes background information on "total maximum daily load."

## Benefits of Daylighting

There are several, often interrelated reasons to return a buried stream to natural conditions. Daylighting and open waterrcourses:

- *Revitalize surrounding neighborhoods* by providing new amenities. Stream investments help motivate investments in nearby properties and businesses. Commercial businesses experience increases in walk-in customers who come to enjoy a stream and stay to buy something;
- *Increase property values,* for example the Strawberry Creek project in Berkeley, California and Arcadia Creek in Kalamazoo, Michigan;
- *Create jobs and job-training opportunities* in the planning, building and maintaining of daylighting projects;
- *Improve water quality* by exposing the water flow to sunlight, air, and soil, which allows growth of aquatic and riparian vegetation that takes up organic and inorganic pollutants;
- *Improve hydraulic capacity*: Open waterways can be designed to slow and infiltrate runoff, preventing downstream flooding and erosion. Designed differently, they can speed the passage of runoff more effectively than culverts, which often clog and choke flows, flooding upstream areas;
- *Save money* by avoiding the incremental cost that culverts impose on centralized storm water collection and treatment systems;
- *Are easier to monitor* for damage than are buried culverts;
- *Create natural habitat and wildlife corridors:* For example, projects in the state of Washington included restoration of salmon passage and habitat as primary objectives;
- *Are educational,* bringing aquatic and stream-bank ecosystems closer to students, and adults;
- *Create recreational and leisure opportunities*, which may range from a challenging new water hazard on a private golf course to places for kids to splash. The aesthetic and amenity value of water is quite high. At a regional level, restored creeks can define a network of urban greenways and paths. At the local level, a creek can be a valuable attraction, even a focal point, in a public park. People familiar with the Strawberry Creek project in Berkeley, California note that its local impact is out of proportion to its small size—the opportunity to hear the soothing sound of running water is a huge draw for people in urban environs; and
- *Reconnect people to nature*: Surveys show that residents support creek restoration because, for example they regard fish habitat and teaching their kids about natural history as important. Many regard "Setting right something we messed up" as important.

Source: Adapted from Richard Pinkham, 2001, Rocky Mountain Institute www.rmi.org

## Understanding Storm Water as an Asset

This table compares old and new ideas about storm water runoff.

| The Old Paradigm | The Emerging Paradigm |
|---|---|
| *Storm water is a nuisance.* Convey Storm water away from urban areas as rapidly as possible. | *Storm water is a resource.* Harvest storm water as a water supply, and infiltrate or retain it to support urban aquifers, watercourses, and vegetation. |
| *Build to demand.* It is necessary to build more capacity as demand increases. | *Manage demand.* Demand management opportunities are real and increasing. Take advantage of all cost-effective options before increasing infrastructure capacity. |
| *Demand is a matter of quantity.* The amount of water required or produced by water end-users is the only end-use parameter relevant to infrastructure choices. Treat all supply-side water to potable standards, and collect all wastewater for treatment in one system. | *Demand is multi-faceted.* Infrastructure choices should match the varying characteristics of water required or produced by different end-users: quantity, quality (biological, chemical, physical), level of reliability, etc. |
| *One use (throughput).* Water follows a one-way path from supply, to a single use, to treatment and disposal to the environment. | *Reuse and reclamation.* Water can be used multiple times, by cascading it from higher to lower-quality needs (e.g. using household gray water for irrigation), and by reclamation treatment for return to the supply side of the infrastructure. |
| *Gray infrastructure.* The only things we call infrastructure are made of concrete, metal and plastic. | *Green infrastructure.* Besides pipes and treatment plants, infrastructure includes the natural capacities of soil and vegetation to absorb and treat water. |
| *Bigger/centralized is better.* Larger systems, especially treatment plants, attain economies of scale. | *Small/decentralized is possible, often desirable.* Small scale systems are effective and can be economic, especially when diseconomies of scale in conventional distribution/collection networks are considered. |
| *Limit complexity: employ standard solutions.* A small number of technologies, well-know by urban water professionals, defines the range of responsible infrastructure choices. | *Allow diverse solutions.* A multiplicity of situation-tuned solutions is required in increasingly complex and resource-limited urban environments, and enabled by new management technologies and strategies. |
| *Integration by accident.* Water supply, storm water, and wastewater systems may be managed by the same agency as a matter of local historic happenstance. Physically, however, the systems should be separated. | *Physical and institutional integration by design.* Important linkages can and should be made between physical infrastructures for water supply, storm water, and wastewater management. Realizing the benefits of integration requires highly coordinated management. |
| *Collaboration = public relations.* Approach other agencies and the public when approval of pre-chosen solutions is required. | *Collaboration = engagement.* Enlist other agencies and the public in the search for effective, multi-benefit solutions. |
| *Human waste is a nuisance*. To be disposed of after the minimum required treatment to reduce its harmful properties. | *Human waste is a resource.* It should be captured and processed effectively, and put to use nourishing land and crops. |

Source: Richard Pinkham, 2001. Rocky Mountain Institute, www.rmi.org

## Urban Runoff Challenges

(Source: 2000 California Urban Runoff Management Survey):

Urban runoff has become a significant water pollution problem. According to the USEPA:

> Runoff from urban areas is the leading source of water quality impairments to surveyed estuaries and the third largest source of water quality impairments to surveyed lakes. In addition, population and development trends indicate that by 2010 more than half of these rapidly growing urban areas will continue to degrade coastal waters.

To understand urban runoff it is necessary to know the difference between point source and non-point source pollution.

Point-source pollution has an identifiable location and can usually be measured. It is the discharge of pollutants, associated with industries or municipalities, to water bodies at such a point as a storm pipe or storm channel. An example is effluent discharge from a wastewater treatment facility. Regulatory agencies from all levels of the government have made strides in managing point-source pollution through regulatory programs such as the National Pollution Discharge Elimination System, which establishes discharge limits, which result in a notice of violation when exceeded.

Non-point source pollution refers to pollution that occurs over a wide area and is usually associated with land-use activities. No exact location or producer can be pinpointed as the origin. Thus regulation of non-point source pollution is a challenge.

Urban runoff is a non-point source of pollution that is the "result of water from rainfall, snowmelt and other water use activities such as car washing, irrigation and street cleaning that becomes contaminated as it travels along the land surface and makes its way to a water body. Regardless of the [ultimate] point of entry 'into the receiving water body, urban runoff has diffuse origins and, therefore, is difficult to manage and control." (EPA, 1993). Urban runoff is categorized as either wet-weather flow or dry-weather flow.

# Total Maximum Daily Load Report

TMDL reports identify and evaluate water quality problems in impaired water bodies and propose solutions to bring those waters into attainment. The goal of a TMDL process is full attainment of the Water Quality Standards.

The Lower Cuyahoga River TMDL report was approved by U.S. EPA on September 26, 2003 under Section 303(d) of the Clean Water Act. (Ohio EPA, Lower Cuyahoga River Total Maximum Daily Load Report, http://www.epa.state.oh.us/dsw/tmdl/LowerCuyahogaFinalTMDL.html

The Lower Cuyahoga River TMDL report notes that the Clean Water Act and USEPA regulations require that Total Maximum Daily Loads be developed for all waters on the section 303(d) lists. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. The process of formulating TMDLs for specific pollutants is a method by which impaired water-body segments are identified and restoration solutions are developed. The goal of Ohio's TMDL process is full attainment of biological and chemical Water Quality Standards (WQS) and, subsequently, removal of water bodies from the 303(d) list. The Ohio EPA believes that developing TMDLs on a watershed basis (as opposed to solely focusing on impaired segments within a watershed) is an effective way to achieve this goal.

*Lower Cuyahoga River Total Maximum Daily Load*

**Basin:** Lower Cuyahoga River in the Lake Erie Basin
**Study Area:** Lower 50 miles of Cuyahoga River and its tributaries.
**Goal:** Attainment of the appropriate Aquatic Life Use
**Major Causes:** Organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration
**Major Sources:** Municipal discharges, combined sewer overflows, urban runoff, and industrial discharges.
**Measure:** Total nitrogen, phosphorus, dissolved oxygen, bacteria, biological and habitat indices
**Restoration Options:** Long term control plans for combined sewer overflows, urban runoff controls, habitat protection and restoration, septic system improvements, point source controls, and public education

Cuyahoga Valley

Respect Rediscover Revitalize

**Cuyahoga Valley Initiative mission**

To provide the tools necessary for the community
to revitalize the Valley
and make it once again an economic force,
environmental treasure,
and unifying element
for the region.