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INVESTIGATING ECO-INDUSTRIAL PARK DEVELOPMENT:

Final Report & Recommendations for Future Consideration

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For The GREEN Institute

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Introduction

This document is the result of an informal survey conducted by telephone with seven environmentally-centered industrial park developments in North America over the course of two months (June to August, 1996). These seven developments are the *Duwamish Corridor Project* (located largely in King County, Washington), *Burnside Industrial Park* (Nova Scotia, Canada), *Fairfield Eco-Industrial Park* (Baltimore, Maryland), *New Jersey EcoComplex* (Burlington County, New Jersey), *Brownsville Eco-Industrial Park* (Brownsville, Texas), *Skagit County Environmental Industrial Park* (Skagit County, Washington) and the *Port of Cape Charles Sustainable Technologies Industrial Park* (Port of Cape Charles, Virginia). In addition, two eco-industrial developments are featured in this document based largely on the materials sent by the respective projects: these are the *Civano Solar Village* (Tucson, Arizona) and the *South Central Business District* (Chattanooga, Tennessee). While none of the projects interviewed are fully operational as yet, the relative perspectives gathered from each project -- regarding such critical issues as tenant clustering and implementation of economic development objectives -- has nevertheless proven exceedingly helpful.

Given the rapidly escalating popularity of the eco-industrial park concept, the information contained in this report is necessarily quite limited: this document is by no means an authoritative pronouncement or indicator of future progress and success. Indeed, eagerly anticipated future documents promise to herald the presentation of more intensive and comprehensive views of the development process as a whole. One example is the upcoming *Fieldbook for the Development of Eco-Industrial Parks*, produced by Indigo Development in conjunction with the Research Triangle Institute: the Fieldbook has been designed specifically to serve as a practical manual for eco-industrial park development. In contrast, this report attempts to record a broad overview, a static snapshot, of dynamic trends and early lessons learned regarding introduction and establishment of the eco-industrial park as a profitable and resourceful alternative to conducting "business as usual." As a result, the information presented is a general assemblage of anecdotes and recommendations, common threads and corporate conjecture that reflects the wide scope of possible involvement for organizations and agencies interested in industrial ecology.

Given the expansive nature of this investigation, three types of information provided the majority of the results presented here. First and foremost, the final draft of the report *Eco-Industrial Parks: A Commonsense Approach to Environmental Protection*, prepared by Stephen V. Dunn for the United States Environmental Protection Agency, and the conference proceedings from the international workshop *Designing, Financing and Building the Industrial Park of the Future*, contributed the necessary foundation for ensuing research. Second, the personal responses from a host of prominent individuals involved firsthand with eco-industrial implementation -- largely project managers and team leaders from public, nonprofit and academic circles -- has helped to accumulate the bulk of information presented in Section I. While a general survey format and template of questions was preserved for the purposes of interviewing each development site, the reader should nevertheless be forewarned that subsequent questions were tailored to pursue information respective to individual projects. In order to draw generic conclusions through exploration of similar and contrasting situations, the informal interviews were not designed to gather quantitative data for either definitive or empirical evaluation. As a result, while the general outline of questions is referenced in an Appendix to this document, the reader is cautioned to use the outline only as a rough guideline. Finally, pamphlets, feasibility studies and other supportive written material, in conjunction with Internet web sites and recent articles detailing the subject of eco-industrial development, has filled out the gaps and provided a more seamless comparison of the sites presented here.

In order to develop more sustainable strategies for the next century, the industrial sector will necessarily have to reevaluate its conventional guiding principles and traditionally marketed practices. Without a doubt, modes of production which generate waste and pollution inevitably incur both environmental

and economic costs. As a result, new interdisciplinary approaches melding both environmental regard and commercial profitability currently lead sustainable development initiatives. Broadly speaking, eco-industrial and related developments may be distinguished most simply by their adherence to the fundamental principles of industrial ecology. Robert Frosch and Nicholas Gallopoulos in their seminal article (*Scientific American*, Special Edition, September, 1989: pp. 144-152), write that "the traditional model of industrial activity -- in which individual manufacturing processes take in raw materials and generate products to be sold plus waste to be disposed of -- should be transformed into a more integrated model: an industrial ecosystem. In such a system, the consumption of energy and materials is optimized, waste generation is minimized and the effluents of one process serve as the raw material for another process."¹ It is from this overarching definition of industrial ecology that the multifaceted concept of eco- or environmental industrial park emerges. Indeed, "Industrial ecology enables the corporate world to work these socio-economic forces to more directly perceive the constraints of the biosphere and to design an organic path of change for the industrial system. It provides common ground for defining sustainability by balancing economic needs with ecological constraints."² According to the Burnside Industrial Park, "The premise of industrial ecology is that the industrial economy -- that system of raw materials extraction, manufacturing processes, product use, and waste disposal -- should mimic the cycling of materials in the natural ecosystem as much as possible. Webs of producers, consumers, and scavengers are essential and symbiotic relationships between companies and industries are encouraged. This ensures that products and by-products of development can be reused, repaired, recovered, remanufactured, or recycled."³ Indeed, industrial development itself represents an entire continuum of fluid environmental perspective, ranging from compliance-oriented to risk-oriented and finally resource-oriented approaches to environmental management. In time, eco-industrial development will encourage a more assertive commitment to long-term and sustainable, resource-oriented models of commercial investment -- a diametric counterbalance to the static, compliance-oriented responses of past and present regulatory frameworks.

According to the US Environmental Protection Agency's 1995 report prepared by Stephen Dunn, *Eco-Industrial Parks: A Commonsense Approach to Environmental Protection*, an eco-industrial park is more an expansive compilation of environmentally-receptive components, than it is a single definitive concept. Indeed, the Environmental Protection Agency's document notes in its executive summary that "A key premise of EIPs is that participating firms will have the opportunity to enhance both their economic and environmental performance through increased efficiency, waste minimization, innovation and technology development, access to new markets, and attraction of financing and investment."⁴ In addition, while a symbiotic relationship between participating businesses is a core characteristic of eco-industrial developments, the report further comments that: "a single byproduct exchange pattern or network of exchanges; a recycling business cluster...; a collection of environmental technology companies; a collection of companies making 'green' products; an industrial park designed around a single environmental theme...; a park with environmentally-friendly infrastructure or construction; and a mixed-use development"⁵ individually do not constitute an eco-industrial park development.

Consistent with the considerable breadth of its definition, the nine industrial parks represented display a wide range of developmental capability. Indeed, their diversity may be respected for its reflection of the fluid variety of options available along the spectrum between "closed loop" waste exchange systems

¹ Dunn, Stephen V. August, 1995. *Eco-Industrial Parks: A Common Sense Approach to Environmental Protection*. p. 1. (Prepared for the US Environmental Protection Agency: Office of Policy, Planning and Evaluation, Office of Policy Analysis, Urban and Economic Development Policy Division.)

² Lowe, Ernest. *Industrial Ecology: a context for design and decision*. p. 5. (Excerpts.)

³ School for Resource & Environmental Studies, Faculty of Management at Dalhousie University. 1993-1996 *The Burnside Ecosystem -- An Educational Initiative for Small Business*. Halifax, Nova Scotia. (Articles written by researchers involved in The Industrial Park as an Ecosystem project.)

⁴ Op. cit. Dunn, p. ii.

⁵ Ibid. p. 2.

and 'green' business incubation. While zero emissions and closed loop designs surely embody an ecological interconnectedness with the natural environment, so too does the environmental incubator, facilitating and promoting the cooperative exchange of technological innovation and novel ideas rather than physical materials or waste outputs. As a result, each of the projects presented in this report are characteristically unique not only with respect to location and site specific variations, but also with regards to the fundamental philosophy driving each respective development. Indeed, although each location is explicitly concerned about environmental and economic efficiency, as well as economic development for the area, the resulting vehicle each has chosen to implement is nevertheless quite singular. In either case, the paramount tenets of sustainability point to the need for the industrial and commercial sectors, prompted by the incentive of newly-authored regulatory legislation and heightened social environmental regard, to turn corporate attention to developing alternatives to traditional resource consumption in product manufacture, distribution and sale.

Information is presented in this document in three sections: the first consists of an inventory of the nine developments surveyed. This section is a compilation of transcription from interviews for the seven sites directly contacted, in addition to information gleaned from various prepared reports, Internet web sites and other secondary materials for all nine sites. The second section of this report consists of a series of spreadsheets condensing highlights of the nine developments for convenient access and comparison across projects. A third section summarizes findings and presents recommendations for future development of an eco-industrial park by the GREEN Institute. Final conclusions are presented following the recommendations of Section III. A comprehensive list of resources used in researching the concept of eco-industrial park developments is listed in the Bibliography to this document.

It is the author's intention that the information presented in this report will serve both as a guide for refining a version of the eco-industrial park concept to best fit the GREEN Institute's theoretical aspirations, as well as provide a practical reference for skillfully and successfully implementing the conceptual considerations to the reality at hand. Furthermore, while this report has been prepared primarily for use by the GREEN Institute for examining the feasibility of developing an eco-industrial park in the Phillips Neighborhood of Minneapolis, Minnesota, it is hoped nevertheless that subsequent organizations and agencies reviewing this document might find the compilation of use in directing their own planning processes. Indeed, with the rising popularity and familiarity of industrial ecology, shared wisdom with regards to widespread promotion of successful sustainability innovation efforts will prove a cornerstone to fusing environmental stewardship with corporate success. Finally, the author wishes to gratefully acknowledge and thank each of the nine eco-industrial park developments who so generously invested their valuable time and insight, feasibility studies and Internet Web sites, into the creation of this report. Their donations of anecdotes and advice has helped to shape both the current industrial ecology environment, in addition to the critical wave of industrial innovation that promises to be soon in coming. While care has been taken to ensure the accurate reflection of eco-industrial park development as surveyed, any errors or omissions are entirely the responsibility of the author.

Section I. Survey of Existing Eco-Industrial Park Development

The inventory presented in the first section of this document is divided into the following main categories: *mission, setting, history, present activity, future objectives, barriers, funding, and partnerships*. The category of partnerships is further distilled into subdivisions for the purposes of documenting *lead, industrial, local, regional, state, national, federal, and academic liaisons*. In addition, the nine projects are listed in the order contacted – specific dates of interviews are noted in the directory spreadsheet of Section II. The reader should be reminded that the following synopses draw liberally from more comprehensive and detailed information available through various reports and electronic web sites.

❖ DUWAMISH CORRIDOR PROJECT

Main Contact:

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King County Economic Development Department
King County Office of Budget and Strategic Planning
King County Courthouse, Room 420
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Seattle, Washington 98104

Mission:

The mission of the Duwamish Coalition is to preserve and reclaim industrial land for the dual purpose of expanding the manufacturing and industrial job bases, and protecting and enhancing the natural environment. Furthermore, the Coalition will address regulatory, infrastructural and institutional barriers to economic growth and environmental protection in the Duwamish Corridor. The stated mission will be accomplished through the intervention of private and multi-jurisdictional public-private partnerships. The Coalition presently pursues the following critically-related objectives:

- Ensure that minorities, women and economically disadvantaged individuals have access to the jobs which may be created through the Coalition's efforts. This includes access to appropriate training to qualify for jobs.
- Ensure that the needs and well-being of neighborhoods within and adjoining the Duwamish industrial area are understood, protected and balanced with economic development goals.

Setting:

A large swath of industrial land, close in proximity to the populous Seattle metropolitan area within King County, the Duwamish Corridor faces revitalization issues with a grave sense of urgency.

History:

The Duwamish Coalition was first convened in April of 1994 to unify efforts in addressing the mounting economic and environmental issues confronting businesses and residents of the Duwamish industrial corridor. The Coalition includes representatives from business, labor, environmental and community groups, local government, as well as state and federal government. Five Duwamish Coalition subcommittees (the Preserve and Reclaim Industrial Land, Regulatory Issues, Water Quality and Habitat Enhancement, Job Creation Initiatives, and the Coordinating Infrastructure Initiatives Subcommittees) were created, each of which employed collaborative decision-making techniques to work through numerous divisive issues, using a consensus process with many stakeholders.

Present Activity:

The Duwamish Corridor Project is concerned first and foremost with the creation of jobs for the economically-depressed area, and for the timely remediation of the degraded environment. Efforts at revitalizing the area are centered around the work of numerous task forces, each addressing specific local concerns, and recently replacing the subcommittee structure. Two exceedingly critical task forces, especially in the context of eco-industrial development and job creation, are highlighted below.

The goals of the Job Initiatives Task Force (formerly the Job Creation Initiatives Subcommittee) are to:

- Implement successful initiatives to retain and create family wage jobs in basic industries in the Duwamish Corridor,
- Ensure that residents of the Duwamish and women, people of color and economically-disadvantaged individuals have access to the jobs created through the Coalition, and finally to
- Provide support to Duwamish area businesses in developing successful working relationships to promote and support a stable and diverse workforce.

In order to facilitate economic development and job creation for the Corridor, in this especially critical and challenging area, the Job Initiatives Task Force compiled the *Duwamish Economic Profiles* report which includes information regarding Duwamish Corridor employers, employment, major industries present within the Duwamish Corridor. Furthermore, the report describes the major areas of economic activity in the corridor and profiles the major, high wage industries in the corridor. The goal of the Economic Profiles report is to identify high wage employers in the corridor and work with them to strengthen their competitiveness.

A series of panel discussion were held with high-wage Duwamish employers in a number of sectors to more accurately assess the basic skills gap in labor force preparation, ability and work readiness that might otherwise be addressed. These discussions were conducted with an assortment of major employers in the area, including: Recycling, Fabricated Metals Products, Food Products, Shipbuilding and Wholesale Trade industries -- each industry category participating in a separate discussion session, in order to more effectively isolate industry-specific responses to the task of job creation and work readiness. A summary report from this series of panel discussions documents the apparent "gap" in basic skills, as reported by the employers.

A responsibility of the Job Initiatives Task Force, the Workforce Linkages Project was designed to create better linkages between employers and training and education providers. The project works with employers, trainers, educators and community organizations in order to provide employer input directly into training and education programs, as well as to create a pool of work ready and qualified applicants. To help educators become more familiar with industrial labor needs and opportunities, the Task Force facilitated a forum ("Preparing for Work: A Forum on Education and Employment") for teachers, employers and community members in February of 1996.

The goals of the Brownfields and Environmental Enhancement Task Force are to:

- Clean up contaminated industrial land and address parcel-size issues so that the Duwamish basin can continue to provide family-wage jobs in local basic industries.
- Minimize and control harmful discharge into the Duwamish River while facilitating industrial development.
- Prevent loss of fish habitat while facilitating industrial development.

The Brownfields Redevelopment/Total Petroleum Hydrocarbon Project of the Brownfields and Environmental Enhancement Task Force will develop and field test a new guidance document for assessing risk and establishing remediation criterion on industrial sites contaminated with TPH. TPH is a known contaminant on a large percentage of properties in the Duwamish industrial corridor (as well as throughout the state), and an expensive barrier to redevelopment of brownfield

sites. The EPA has granted the Washington State Department of Ecology \$150,000 for this project, which is matched by \$100,000 from local governments.

The Redevelopment Demonstration Project, originated by Metropolitan King County Council ordinance, will provide technical and financial assistance in reclaiming contaminated land in the industrial corridor. Six projects have been selected as demonstration projects and were submitted to the Council and other local jurisdictions for funding consideration and technical assistance.

The focus of the Industrial Ecology Project is to create an inventory of industrial wastes produced in the Duwamish Corridor, and subsequently to encourage the use of such wastes as inputs to new product manufacture. The benefits of the project will include lower disposal costs for businesses and lower volumes of waste deposited in landfills. The Duwamish Corridor Project was chosen to receive funds to conduct an in-depth survey of businesses within King County to better assess the potential for waste exchanges between industries in the area: the US Environmental Protection Agency has granted the King County Economic Development Program \$20,000 for these efforts, matched with \$12,000 by King County.

Recommendations resulting from the Finance and Liability Project address the complicated financing and liability issues surrounding the clean up of contaminated properties in the Duwamish Corridor. These references include establishing a commercial lending pool to assist businesses in conducting environmental assessments and to cover remediation costs, creating a Public Development Authority to coordinate clean up and other activities in the area, and providing regulatory reform. Seafirst Bank has indicated a willingness to provide leadership in forming a loan pool.

The Environmental Extension Service program would provide a range of environmental engineering services to manufacturers in the Duwamish Corridor. The purpose of the program is to help companies design new manufacturing processes which will generate fewer waste products and otherwise be more environmentally-sound. Services could include assistance with contaminated land clean up, assistance with pollution prevention technologies and services, and assistance with industrial waste exchanges. This program will be implemented through a consulting contract.

The City of Seattle and King County have submitted a grant application to document the groundwater pathways for the Duwamish industrial corridor. The Hydrogeologic (Groundwater) Project is designed to benefit individual property owners interested in expanding, redeveloping or selling their property. The project will simultaneously assist regulators in determining whether individual properties are contributing to groundwater contamination in the area.

Future Objectives:

More explicit, strategic plans for the development of an eco-industrial park within the Duwamish Corridor lie in the future, after results from the survey of industrial waste processes and exchanges have been meticulously evaluated.

The Business Assistance Program has been established to provide a coordinated approach to assisting businesses with regulatory compliance. The program will be tailored to address specific problems within the current system of regulations -- including those of conflicting regulations between various public agencies, lack of flexibility to accommodate new and innovative technological processes (such as waste exchange between businesses), and lack of dispute resolution avenues to encourage consensual compliance and remediation. Services to be provided will include a coordinated referral network, non-regulatory compliance assessments, an advocacy service, and rule development and implementation coordination. Funding for many of the elements of the Business Assistance Program are in place for this year.

The Hamm Creek Regional Stormwater and Habitat Project provides a cost-effective, systemic solution to the economic development, water quality, drainage and habitat concerns of Hamm Creek. The project will provide a regional stormwater facility for property owners, eliminating the need for parcel-specific stormwater facilities. This in turn, will help businesses by freeing up more land for development and eliminating the regulatory burdens and costs associated with permitting and maintaining individual facilities. This project is not funded as yet.

Barriers:

Barriers to the revitalization, the consequent enhancement of both economic and environmental quality of life in the Duwamish Corridor are complex and intertwined. Among the most serious, are environmental challenges that include water quality and habitat improvement -- these are especially sensitive issues that require the long-term investment and committed action of many disparate stakeholders.

Furthermore, regulatory challenges including, those of regulatory reform, are of particular relevance for the future success of the Duwamish Corridor Project. The *Environmental Barriers to Redevelopment (Problems) Report* funded by the City of Seattle with the use of federal funds attempts to address the potential role of the City of Seattle in resolving the manifold impediments to site remediation and redevelopment. Implementation of suggested industrial policies and programs recommended by the *Seattle Industrial Lands Base Study* should prove useful in alleviating the present regulatory pressure apparent in the static regulatory framework of today, at the same time stimulating a healthy regard, a respect for the natural processes at work in the larger surrounding environment.

Funding:

US Environmental Protection Agency: \$20,000.00 to the King County Economic Development Program, matched with \$12,000.00 by King County

US Environmental Protection Agency: granted the Washington State Department of Ecology \$150,000 for the Brownfields Redevelopment/Total Petroleum Hydrocarbon Project, in turn matched by \$100,000 from local governments

Partnerships:

Industry:

Aerospace Machinists District Lodge 751
Delta Marine Industries
Foss Environmental Services
Fraser Boiler, Inc.
Galvin Flying Service
Key Bank
Kidder, Mathews & Segner
Long Painting
PACCAR, Inc.
Preston, Gates & Ellis
Seafirst Bank
Seidelhuber Iron and Bronze Works
SGA Corporation
The Boeing Company

Local:

City of Renton
City of Seattle
City of Tukwila
Duwamish Industrial Education Center
Environmental Coalition of South Seattle

Georgetown Crime Prevention Council
People for Puget Sound
Port of Seattle

Regional:

King County
King County Labor Council, AFL-CIO
SODO Business Association
South Park Area Redevelopment Committee

State:

State Representative Eileen Cody
State Representative Velma Veloria
State Senator Margarita Prentice
Washington Alliance for Manufacturing
Washington Environmental Council
Washington State Department of Ecology
Washington State Department of Natural Resources

National:

Muckleshoot Indian Tribe
Suquamish Indian Tribe

Federal:

United States Environmental Protection Agency

Academia:

❖ BURNSIDE INDUSTRIAL PARK

Main Contact:

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Mission:

This Atlantic Canadian project titled "The Industrial Park as an Ecosystem" considers how best to apply the principles of industrial ecology to an established industrial system. As a result, the project closely examines the Burnside Industrial Park as one example of one model of industrial development, in order to explore the new opportunities, both environmental and economic, afforded to industry under the auspices of strategic eco-industrial development.

Setting:

Located in Dartmouth, Nova Scotia, the park incorporates some 1,300 single and mall unit businesses representing a wide range of industry sectors, and employs a working population of over

20,000 individuals. Mostly small to medium business are located at the Burnside Industrial Park, allowing for greater exploration of the financial feasibility of waste exchanges between businesses, for these less typical size categorizations.

History:

The Burnside Industrial Park has been in operation some twenty-five years as a traditional industrial park. It was chosen by the School for Resource and Environmental Studies as a demonstration eco-industrial park for the wide diversity it displays with regard to the types of businesses located there, and with regards to the possibilities for retrofitting existing industrial parks according to a 'closed loop' standard of environmental performance. The Burnside Cleaner Production Centre was established in March of 1995 to provide information on waste reduction, pollution prevention, and cleaner production to businesses in the Burnside Industrial Park. To this end, the Centre contains an extensive library of over 1,000 publications -- covering such topics as waste reduction, pollution prevention, recycling, new technologies, sustainable industrial ecology and economic development - in addition to providing access to various databases, including the *WasteInfo* CD-ROM.

The research team, involving scholars from two universities and practitioners from local consulting firms, spent approximately twenty months conducting various studies in the park. To generate data for the study and encourage eventual materials exchange among tenants, a sample survey of 278 businesses in the Burnside Industrial Park was undertaken during the summer of 1992.

Representing some 25% of businesses located at the park, responses from the survey were used to develop a prototype database. Furthermore, on the basis of an extensive literature search and analysis of the specific conditions characterizing Burnside, the team formulated a set of principles and guidelines governing the operation of industrial parks within an ecological framework. These guidelines, available through the publication *Designing and Operating Industrial Parks as Ecosystems*, include recommendations regarding the environmental design of parks and buildings, as well as a series of strategies which designed to encourage interaction among businesses in an industrial park setting. Practical methods and technological advances to reduce waste generation for selected waste streams were also identified. Finally, the project team identified potential symbiotic relationships between various industries and highlighted the mechanisms necessary to support the industrial park as a single ecosystem.

Present Activity:

While literature regarding waste reduction, cleaner production and industrial ecology is undoubtedly becoming more readily available, small businesses -- such as the majority of those found in the Burnside Industrial Park -- have not the critical finances, time or technical capability to research and implement the most pertinent information. Given such demonstrated constraints, most present activity at the park is centered around multifaceted educational initiatives targeting the business community. To this end, the Centre has developed a series of eighteen *Waste Minimization Fact Sheets* and a collection of *Success Stories* highlighting businesses in the Burnside Industrial Park who have successfully implemented waste reduction strategies. A prototype information management system, the software *ECOPARK*, is being designed for use by industrial park managers and other business interests to align particular or comprehensive waste reduction and related needs with the information currently available. A monthly column titled *The Burnside Ecosystem* is included in the local newsletter for the purposes of building awareness of industrial ecology issues and opportunities among the park's tenants. Other available publications include *The Industrial Ecology Reader*, *Towards a Burnside Ecosystem*, and the compendium *Industrial Parks as Ecosystems: Updated Bibliography*.

Several industrial categories were chosen to more closely examine potential opportunities and barriers to improved efficiency and conservation, both *within* and *between* businesses. These sectors include the commercial printing, vehicle maintenance, computer assembly and distribution, electronics sales and service, chemical manufacturing and distribution, metal processing, and paint

and coatings industries. For these *Sectoral Case Studies*, the opportunities for cleaner production were outlined as those occurring within a given business itself, as well as possible connections for exchange between businesses. Within businesses, more environmentally-benign processes include the substitution of hazardous materials for water-based and vegetable-based products (such as vegetable oil inks); the rental of industrial wipers; the use of catalogues on diskette and electronic mail. Potential exchanges between businesses include the reuse of water; both a silver and fixer recovery network; the reuse and recycling of plastic containers; the donation and reuse of computers and related components from businesses to public, academic and other facilities; the recycling of metal and other materials for use in jewelry and handicrafts; and finally the reuse of packaging materials.

A second component of the project, the *Cross-Sectoral Case Studies*, investigated similar opportunities and barriers to improved cycling of materials across both individual businesses and business sectors within the established industrial park framework. Indeed, as business and industrial parks are increasingly composed of multiple unit buildings, or malls, such subsystems display as a result a distinct 'ecological' dimension. Both actual and potential symbiotic relationships between collocated business units were explored; packaging was found to represent a particularly significant proportion of waste material discarded in the Burnside Industrial Park. Consequently, the study supports establishment of a Centre for Packaging Reuse as one ready mechanism for promoting the ecological design, manufacture and use/reuse of packaging materials within the park. In addition, the Burnside Cleaner Production Centre conducts waste and material audits for interested businesses in order to promote the exchange of both. An individual business' input, associated processes, and output are carefully analyzed in order to recommend tactics that will assist the company in reducing waste and developing a symbiotic relationship with other businesses, both within the particular industry as well as within the larger environs of the Burnside park itself.

Future Objectives:

The Burnside Industrial Park project team will continue to investigate the possibilities and implications of symbiotic relationships within the context of an established industrial park. Investigative studies will be conducted which will explore the feasibility of creative packaging reuse centers, the barriers inherent in paint swaps and chemical exchanges, and the possibility of companies within a given industry working cooperatively to purchase waste recovery equipment. Furthermore, the Burnside project team will be supervising a study of the development of an "ideal" mall: in which energy, water, and other resources are used efficiently. A third project will focus upon a single material, for example solvents, and study waste reduction technologies for that material based upon the tenets of industrial ecology. Furthermore, the team has been requested to develop a comprehensive *Technical Manual on the Environmental Management of Industrial Parks*, for the United Nations Environment Programme.

An intended outcome of "The Industrial Park as an Ecosystem" project is the formulation of a series of computerized databases which will serve as tools for managers and other interested decision makers to identify applicable waste reduction technologies and processes. Indeed, the effective and efficient use of resources within the Burnside Industrial Park, in order to further limit the amount of waste discharged beyond the park, is the ultimate objective of the project.

Barriers:

Among the more significant barriers faced by the Centre includes the fact that the Burnside Industrial Park has no single park or property management agency or authority. In other words, no *one* development corporation or management team is responsible for setting policy or overseeing daily affairs. As a result, approaching individual tenants (whose owners are often absentee landlords) has not been entirely efficient or effective, in many cases. In addition, the respective interest levels of specific tenants in industrial ecology has been difficult to cultivate: attitudes on the whole appear to be quite conservative, and individuals overall are reluctant to change. Given their

size, small and medium businesses understandably recognize few larger incentives; the promise of a profitable return, given heavy resource investment in waste minimization and exchange technology, exists too far into the uncertain future. Furthermore, with an 'excess' supply of both water and energy in Atlantic Canada, there is little or no incentive for companies to save either commodity -- both resources are fairly inexpensive and subsequently, continue to be undervalued.

Barriers to the general establishment of the concept of eco-industrial development are largely three-fold. The first barrier exists as initial sale of the idea to the developer: both design and construction concerns are integral to the development of the eco-industrial park. In addition, given that up-front costs for eco-industrial parks are likely higher than those for more traditional developments (though future operating costs should correspondingly be lower), it may prove difficult indeed to persuade developers to invest in the former. Secondly, legal and regulatory codes are similarly not conducive to participation in eco-industrial development. Strictly-defined categorizations and procedures for handling of hazardous waste for example, do not facilitate easy alternatives for reuse or recycling of such materials between companies. Finally, the creation of various economic instruments is critical for attracting and ensuring corporate support and long-term commitment. Multidisciplinary teams composed of architectural, planning, legal, and other technical expertise is warranted in crafting effective strategic plans for the realization of eco-industrial park development.

Funding:

Partnerships:

Industry:

Local:

Regional:

State:

National:

Federal:

Academia:

School for Resource and Environmental Studies, Dalhousie University

❖ FAIRFIELD ECO-INDUSTRIAL PARK

Main Contact:

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Cornell University

PEWS / NYSSILR

Work and Environment Initiative

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Mission:

The Work and Environment Initiative at Cornell University is an interdisciplinary program that includes the committed participation of such diverse stakeholders as management, labor unions; public, environmental and community organizations. The Initiative firmly believes that the surrounding environment is an essential complement to the workplace environment and must be respected as such, rather than relegated as a distinctly separate entity. Indeed, the threads linking environmental degradation to work site and community conditions is most often subtly and irrevocably intertwined. The Fairfield Eco-Industrial Park seeks to integrate, respect and conserve both the natural resources of fuel and water, as well as those of labor and human capital. The overarching objective of the Cornell Work and Environment Initiative is the critical examination of new and innovative methods to improve environmental performance at work, while simultaneously increasing employment opportunities in the environmental sector. The philosophy employed in developing the Fairfield Eco-Industrial Park is that the connection between high performance work, sustainable and profitable commercial returns, and high quality employment must be clearly recognized and consequently reinforced.

Setting:

The Fairfield Eco-Industrial Park location in Baltimore, Maryland has commanded a unique role in the city's history. In the past century, Fairfield demonstrated a heavy reliance on the agricultural sector of the economy, transformed in the present century to dependence upon massive industrial production. Reasonably, Baltimore developed an incredible industrial capability largely because of its access to natural resources as well as its proximity to transportation and distribution outlets. The location is a federally designated Empowerment Zone, while the intended eco-industrial park site is an underutilized brownfield site presently undergoing remediation.

History:

Cornell University's Work and Environment Initiative was established in 1992 in order to more appropriately address the fundamental connections linking environmental, human resource and community issues. The first attempt at developing an eco-industrial park by Cornell University's Work and Environment Initiative was undertaken in Rochester, New York. While the Rochester project has since stalled, the Fairfield Eco-Industrial Park situated in Baltimore was recognized by the President's Council on Sustainable Development as one of four national demonstration sites. The Work and Environment Initiative has promoted wider participation and discussion in the overall design and implementation of eco-industrial parks, both nationally and abroad -- indeed, the Cornell project seeks to become a critical catalyst and resource nexus supporting similar developments the world over.

Extensive surveys of 39 commercial enterprises in the community surrounding the park site were conducted by project analysts. From these results, it was readily apparent that many existing and growing industries in the immediate vicinity are based on the processing of carbon -- indeed, the mix of companies represented included concentrations in oil, chemical, asphalt business and transportation. Interestingly enough, the survey discovered that while most of the companies rely upon carbon as a material input and all depend upon an input of energy, nevertheless the vast majority of businesses operate entirely independent of the others. Given the respective characteristics of the Fairfield site, an eco-industrial park may therefore be more precisely designed to accommodate and incorporate existing 'organic cycle' industries. As a result, the project team recommended the implementation of a set of pollution prevention strategies as well as resource recovery facilities able to process carbon-based waste.

An environmental business incubator will be incorporated into the Fairfield Eco-Industrial Park facilities to further promote the development of environmentally-attentive industries. Economic development is also a designated priority for the project team -- the creation of upwards of 2,500 new jobs are predicted for the park in the upcoming ten years, in addition to associated growth in

the environmental sector. Furthermore, the Fairfield Eco-Industrial Park aims to provide a return on assets of a minimum of 30 to 50% above the industry average for investment.

Present Activity:

Cornell University's Work and Environment Initiative serves as the much needed network facilitator and mediator for connecting the various parcels of the Fairfield Eco-Industrial Park together. The project team maintains a broad database and inventory of individuals, agencies, corporations and other organizations interested in the process of developing the Fairfield industrial site. While no business clusters have as yet been formalized, over 60 companies have been identified both nationally and abroad as potentially fitting a unique and pertinent "market profile." Established by the project team, the profile selects for companies within a given size range with a demonstrated record for environmental regard. The team maintains that these businesses increase the probability of success for the park overall. Furthermore, the community has also played a highly significant role in the process of shaping the Fairfield Eco-Industrial Park by participating in a design charrette. An eco-industrial site familiar with negotiating the various technical hurdles befalling project implementation, the Fairfield Eco-Industrial Park currently shares its accumulated experience and expertise in this field with numerous other interested developments around the nation. Extensive bibliographies and other databases are available from the Work and Environment Initiative at Cornell University for further in-depth information regarding such topics as industrial ecology and sustainable development.

Future Objectives:

With an extensive inventory and directory of potential industrial partners firmly in hand, the Fairfield Eco-Industrial Park team next expects to examine and negotiate more specific relationships between collocated tenants in the park.

Barriers:

One particularly disruptive barrier specific to the eco-industrial development at Fairfield has unfortunately been that of bureaucratic inertia. While it is undoubtedly exceedingly important to attract and recruit decision makers early on in the process of development, the issues accompanying consensus and successful implementation of project plans are nevertheless not swiftly resolved.

Barriers to the successful development of the eco-industrial park concept, in general, are numerous. A particularly significant impediment is the classification of materials as hazardous waste, and the accompanying Resource Conservation and Recovery Act (especially Subtitle C) regulations pertaining to their safe and expedient disposal. Innovative programs like the federal US Environmental Protection Agency sponsored *Project XL* will prove to be very useful in demonstrating the possibilities and limitations of achieving high environmental performance standards, while allowing for unconventional use and reuse of hazardous waste materials. Multilevel reporting is furthermore strongly encouraged in order to strengthen accountability and encourage information exchange among the various stakeholders participating within an eco-industrial park framework. The critical issue of liability is perhaps best mitigated by making participants themselves directly responsible. In other words, both the businesses on the immediate receiving and sending ends of a particular waste exchange should be penalized for faulty handling of a toxic substance in the event of wrongdoing. The eco-industrial park as a discrete whole indeed, should not and can not assume liability for the actions of two or more businesses working in partnership.

The Fairfield Eco-Industrial Park stresses the significance of conducting a baseline study: both for its comprehensive assessment of the particular conditions respective of the given location, as well as for its ability to create a distinct profile for the development. Additionally, the project team strongly recommends that careful attention be paid at the start to attracting a suitable anchor tenant. Specifically, the anchor tenant should be a business of very high value-added output: recycling

agencies and power plants have traditionally been considered successful anchor industries. Furthermore, the anchor as well as all other tenants must fit the local business and environmental ecology specific to the site under consideration. Indeed, prevailing micro-conditions of the locale should serve to shape development of the park: including those of unique industrial, environmental, commercial, historic, social and political value. Finally, future eco-industrial developments are reminded to market the concept of industrial ecology as a practical business investment rather than as an appeal to environmental sensibilities. Indeed, zero emission eco-industrial parks operating efficiently at proven, low overhead costs is perhaps the best advertisement for participation in industrial ecology.

Funding:

Federal designation as an empowerment zone: some \$100 million has been pledged to the entire zone (no funds have been expended as yet)
City of Baltimore: funds pledged
Various economic development agencies
United States Department of Commerce: \$1.2 to 1.5 billion investment

Partnerships:

Industry:

Local:

Baltimore Development Corporation

Regional:

State:

National:

President's Council on Sustainable Development

Federal:

Academia:

Work and Environment Initiative, Cornell University

❖ **NEW JERSEY EcoCOMPLEX**

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Mission:

The New Jersey EcoComplex has been created to stand as a multi-institutional, multidisciplinary demonstration project which will direct research and education resources towards the development of innovative environmental technologies. It is intended to be an environmental experiment station designed primarily for the purposes of research, research demonstration, education and outreach.

To this end the EcoComplex will encourage the demonstration of innovative environmental technologies from a plethora of participating organizations, including academic, public and private research institutions. A focus on demonstration in turn brings attendant opportunities for technology transfer and venture capital investments to the forefront. The industrial application of such new, environmental solutions to age-old issues is a prerequisite for promoting growth in southern New Jersey that is viable both economically and ecologically. Therefore, the EcoComplex supports economic development initiatives targeted specifically toward expansion of the environmental sector, especially those industries concerned with remediation, food and agricultural production, and the protection of environmental quality.

It is imperative for the New Jersey EcoComplex to generate, as well as be regarded as, a positive influence on the state of New Jersey as a whole. Consequently, it is similarly equally significant to the project team that the EcoComplex not be considered simply one more strident program pronouncing ultimatums in the name of so-called 'black and white' environmental issues. For this reason, the New Jersey EcoComplex has plunged headfirst into the practical applications of environmental and economic sustainability. The objective of the project is the collection of agencies and organizations to the EcoComplex site capable of generating the leading edge research and technology. These in turn, will serve to draw companies to locate in the area, at once creating jobs and marketing the EcoComplex competitively in the rapidly expanding environmental industry sector. Housing a diversity of environmental companies, agencies and organizations, the New Jersey EcoComplex intends to incorporate both the issues and solutions of the most pressing environmental dilemmas of today.

Setting:

New Jersey is in itself perhaps, a representative microcosm of more widespread environmental concerns – due largely to its population density, high quality of life and history of reliance on an industrial economy. Originating as an initiative by the New Jersey Agricultural Experiment Station, the New Jersey EcoComplex was a concerted response to the pressing environmental challenges commanding the state's attention. The intent of the project was therefore to adeptly coordinate multiple disciplines and sources of research support in order to address critically complex environmental issues in a timely and innovative manner. Located on Route 295, near the New Jersey Turnpike in the southern portion of the state, the EcoComplex has tremendous potential transportation capacity.

History:

The New Jersey EcoComplex, while not operating on a closed loop system of materials exchange, is a consortium of universities and government agencies facilitating economic development through the promotion of environmental industries, including remediation, solid waste recycling and innovative agriculture.

While agriculture is not a major economic player in New Jersey, it nevertheless plays an important role in the overall economic environment of the state as a whole. As such, agriculture should exert a positive influence on the state, rather than the negative influence it is often perceived as having. The first project established by the New Jersey EcoComplex was the completion of a one acre co-generation research greenhouse. This experimental facility is located adjacent to and powered by methane from the local Burlington County Resource Recovery Facility landfill. Indeed given the levels of methane generated on site, tomato and other crops may at least potentially be harvested all year round. The demonstration greenhouse continues to be one essential element of the New Jersey EcoComplex, exploring the vital connections between commercial agriculture and environmental clean-up. In addition, the EcoComplex has entered into a partnership with the Burlington County Occupational Training Center, providing training and new employment in the greenhouse for developmentally disabled individuals.

Present Activity:

Currently, articulation agreements are being constructed to ease regulatory burdens for businesses interested in joining the EcoComplex. The agreements are a series of reciprocal permits, presently incorporating only a handful of states. A permit issued to a business for a particular process in New Jersey for example, would similarly be respected in California and Illinois. This step is essential for gaining more widespread public exposure for the complex, as well as offering the attractive selling point of more easily-accessible markets for the purposes of recruiting business.

Future Objectives:

Full-scale design and construction of the headquarters on site is the next priority for the project team. Indeed, the headquarters of the New Jersey EcoComplex aims to be the resource recovery demonstration site and meeting grounds for all partners involved. To this effect, the building will include laboratories to facilitate research projects that will specifically target technology transfer and application opportunities. In addition, pilot scale facilities will permit the demonstration and showcase of inventive environmental advances to a diverse audience of potential consumers, investors and other interested stakeholders. The EcoComplex will nurture new environmentally-based businesses in the Burlington County Incubator, as well as support and further develop an expanding network of interested members and committed participants. To this end, the building will provide office space for the Burlington County Office of Solid Waste Management, the New Jersey Corporation for Advanced Technology, the Small Business Development Center, and the Center for Management and Entrepreneurship in order to support the environmental incubator component of the project. The headquarters building will similarly house office space for project managers and participating organizations, including on staff environmental extension specialists, scientists, engineers and technicians. Designated classrooms and meeting space will be used for continuing education initiatives: both for further preparation of elementary through undergraduate level students, teachers and the general public, as well as for ongoing training of professionals well established in the field. Finally, an Information Center will host material especially relevant to public officials and other decision makers.

Community involvement has been a less critical priority to date; no community advisory group has as yet been necessary to input into, or comment upon, the process. With funding intact for construction of the site building itself however, the community now plays a crucial role in the process: indeed, the community is in fact a 'permanent tenant' in the EcoComplex. As a result, garnering active participation by the surrounding communities is now a foremost priority for the park project team. In addition, corporate partners have not as yet been secured or formalized: though without prior solicitation, a few companies have nonetheless demonstrated interest in locating at the EcoComplex site. Furthermore, a commercial developer intends to develop the property immediately adjacent to the EcoComplex into a full scale, materials exchange eco-industrial park. In this way, the New Jersey EcoComplex fulfills important functions as both advisor and recruiter to the eco-industrial park. Given such close proximity to a landfill site, the future eco-industrial park will likely attract businesses using waste resources from the fill as high value added input material for the manufacture of new products.

As new opportunities and offers of support are attracted to and generated by the New Jersey EcoComplex, it is expected that a broad spectrum of environmental issues will be addressed by interdisciplinary teams on site. Indeed, a wide diversity of topics -- including those of plastics recycling, co-product use, bio-remediation, detoxification of waste streams, treatment of biosolids, development of sound agricultural methodology for harvesting non-traditional high-value non-food/non-feed crops, and inventive treatment of food processing waste streams -- may readily be targeted as critical contemporary environmental issues.

Barriers:

The New Jersey EcoComplex recommends that small steps be taken from the very start of developing an eco-industrial park. Furthermore, the project team stresses that establishing formal partnerships is absolutely crucial and should be maintained as a first priority for the development team. Specifically, a government advocate is essential for promoting the eco-industrial park among wider circles: for the New Jersey EcoComplex, the Commissioner for the New Jersey Department of Environmental Protection fulfills this role. Of paramount importance to environmentally-based industrial developments is research and permitting; participating companies require concrete guarantees either with respect to access to skilled labor markets, or else to cooperative ventures with public agencies. In this vein, it is important to diversify investment in the eco-industrial development in order to minimize risk. Reasonably, firm ownership of the concept is tantamount to the eventual success of the development; as a consequence, clear and relevant articulation and presentation of the park concept is fundamental. On-going public relations regarding the status of the park is a clearly relevant task for the project team. Envisioning opportunities and marketing innovation will help to promote the eco-industrial park, while attention to shared objectives versus isolating disparities, will in turn build consensus.

Funding:

New Jersey Higher Education Trust Fund: for upgrading the facility
\$6,000,000.00 for building of office space and laboratory complex
Economic development funds
National Aeronautic and Space Administration (NASA): \$5.0 million from award of the nationally-competitive "NASA Specialized Center of Research and Training (NSCORT)" grant for housing the Center for Bio-Regenerative Life Support Systems
\$3.5 million for development of a greenhouse facility on site
Burlington County Board of Chosen Freeholders/Rutgers University: \$2.5 million for development of co-generation greenhouse facility
New Jersey Commission of Science and Technology: enables Phytotech and the AgBiotech Center of Rutgers University to participate in research at the site
New Jersey Department of Environmental Protection: proposal on landfill mining and plastics recycling at the site
HEFT funds: grant proposal -- matching appropriation of building site and \$1.0 million construction of building (by Burlington County Board of Chosen Freeholders)
Burlington County Board of Chosen Freeholders: \$1.0 million for building and appropriation of building site
Rutgers University: in-kind grants of staff, facilities and equipment
Stevens Institute of Technology: in-kind grants of staff, facilities and equipment

Partnerships:

Industry:

Phytotech
TRC Companies, Inc.
New Jersey Corporation for Advanced Technology

Local:

Regional:

Burlington County Board of Chosen Freeholders:
Burlington County Resource Recovery Facility
Burlington County Office of Economic Development
Burlington County Occupational Training Center and Special Services School
Burlington County Office of Solid Waste Management

State:

New Jersey Department of Environmental Protection

National:

Federal:

National Aeronautic and Space Administration

Academia:

Cumberland County College

Richard J. Stockton State College

Rutgers University:

School of Business at Camden

Small Business Development Center

Center for Management and Entrepreneurship

AgBiotech Center

New Jersey Agricultural Experiment Station

EcoPolicy Center

Environmental Science Department

Stevens Institute of Technology:

Center for Environmental Engineering

Center for Product Lifecycle Management

❖ BROWNSVILLE ECO-INDUSTRIAL PARK

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Mission:

The objective of the Brownsville Eco-Industrial Park is the development of an integrated community of manufacturing and service businesses which will simultaneously encourage economic efficiency and sound environmental practice. The park will mimic natural processes by reflecting 'closed loop' systems of operation: the primary goal is improved economic performance of participating businesses through the reduction of existing inefficiencies in resource consumption. To this end, the Brownsville Eco-Industrial Park will accentuate the use of relevant pollution prevention, materials reuse/recycling, and waste exchange technology.

Setting:

The intended Port of Brownsville site incorporates many industrial and commercial advantages, including: ease of transportation, access to an established industrial base, not to mention its valued proximity to Mexico. Furthermore, the site is a designated brownfield site that has undergone remediation.

History:

Designated one of four President's Council on Sustainable Development demonstration sites, the Brownsville development nevertheless received much of its publicity and promotion through the efforts of City Commissioner Jackie Lockett. In August of 1994, the Research Triangle Institute and Indigo Development received a contract from the US Environmental Protection Agency to study

eco-industrial park development in the United States. In October of the same year, the Research Triangle Institute prepared a case study of potential industry matches for the Brownsville site based on surveys conducted with local businesses. From these results, a number of scenarios building up from baseline conditions were projected in order to reflect the possibilities inherent in development of an eco-industrial park at the Brownsville site.

An Industry Advisory Board composed of some ten to twelve representatives from the industrial, service, environmental and academic sectors was convened in order to provide input into the project. Specifically, the Advisory Board is responsible for evaluating the strategies, criteria and other standards recommended for adoption by the Brownsville Eco-Industrial Park.

Present Activity:

In October of 1995, the Brownsville Eco-Industrial Park received federal support from the US Department of Commerce for a one year feasibility study, expanding research conducted for the earlier *Case Study*. Specifically, the Texas Engineering and Extension Service is compiling information regarding material input, related processes and waste outputs for industries located within a three-county area. While the previous study authored by the Research Triangle Institute examines waste exchange possibilities, the current database will pinpoint effective matches for materials exchange both between companies in the area and those which fit a prescribed industrial market profile. The current feasibility study will progress from the simple linkages manifest in two to three industries, to incorporation of some 50 specific and 100 generic industries pertinent to the Port of Brownsville locale. The former include Levi Strauss, Trico Technologies, Magnetek and Rich SeaPak; the latter categories include pulp and paper, iron and steel, agriculture and aquaculture industries. Indeed, the present industrial database will reflect an advanced system of symbiosis. Furthermore, the database is being designed with a 'search-and-match' capability to better evaluate potential exchanges between businesses for materials with no other pre-identified use. Finally, the study will include a technologically-feasible, mass flow industrial symbiosis plan for both the region and the city at large.

The results of the database will in turn be used to construct a computer simulation (based on the PINS Model used in the refinery industry) by Bechtel Corporation to predict and further quantify possible scenarios for future development at the Port of Brownsville location. The planning model will link by-product and waste streams to appropriate feedstock requirements to postulate profitable, target tenant combinations within the park as well as distinguish related cost savings for these companies. Furthermore, the database and computer model fulfill two critical functions for marketing of the eco-industrial concept. First, they will serve as an intensive and comprehensive evaluation of available quantitative data; second, the two will serve as a concrete and objective tool 'proving' the feasibility of the eco-industrial park concept for industries hesitant to commit. At a future date, the simulation model may be made available by Bechtel Corporation to other interested eco-industrial park locations for similar analysis and evaluation of local profile industries. Finally, the Texas Natural Resources Conservation Commission is working to develop and implement an inventive, effective and efficient regulatory framework to further assist companies participating in the eco-industrial park.

Future Objectives:

Future strategic investment in the site at Brownsville will depend largely upon results of the survey and subsequent model scenarios: a national conference has tentatively been planned for January of 1997 to publicize the research results as well as to begin marketing the park to potential tenant companies. Neither firm criteria regarding tenancy in the development or corporate partnerships have as yet been formally established. As results from the Phase I research study are documented, the project team will work to identify specific niches for new and local businesses to fill in the eco-industrial park. Similarly, the feasibility study will highlight the infrastructure requirements necessary to incorporate an eco-industrial development on site, with particular emphasis on

establishing facility criteria, development costs and requisite park management structure. Furthermore, the project team will focus on the possibilities of introducing special financial incentives and an 'umbrella' permitting framework, in order to ease economic and regulatory burdens.

With results pending from the simulation model, closer attention will be paid to formulating a comprehensive strategic plan to inaugurate Phase II of development, which will incorporate next steps and incumbent timelines. In conjunction with finalizing Phase II decisions, greater cooperative community participation will be sought with respect to park development. Additionally contingent upon the specifications resulting from the simulation, further fundraising and marketing efforts may be tailored toward more receptive avenues. Eventually, the project team expects that some combination of both a 'real' -- or collocated -- and virtual eco-industrial park, housing some ten to twelve tenants, will be developed on site. Once again however, scope, magnitude and speed of the immediate development will depend largely on conclusions drawn from the database and simulation results. Finally, particular attention will be paid to the priority issues of water and landfill space at the Port of Brownsville site as the plans for the park become more formalized during Phase II of the project.

Barriers:

The single largest impediment to development of an eco-industrial park at the Brownsville site has been lack of information clearly linking participation in industrial ecology with demonstrated profit. Furthermore, there appears to be little in the way of an accessible inventory which catalogues the extent of partnering possibilities available for businesses interested in materials exchange. Indeed, one of the demonstrated benefits of an eco-industrial park is the fact that participating businesses are made aware of multiple sources of input feedstocks, as well as introduced to users of recycled output streams. Given such connections, there is a reduced dependency on single suppliers or receivers of any given material. To this end, one barrier to the development of eco-industrial parks is the necessity for mutual trust and cooperation among a diverse set of industries. A strong working relationship with local industries therefore is valuable for incorporating their participation on a continuing basis: a healthy exchange of information regarding potential niches and attractive companies is a critical asset to the development. In order to ensure appropriate ownership of the concept, the Brownsville project team emphasizes the importance of gaining feedback and other critical input from the local industrial sector from the very start of the project. Indeed, the team maintains that industrial consumers must be convinced of the ultimate profitability of industrial ecology precepts in order to guarantee long-term, and more widespread, application of those principles. It is this commitment from industry, and the resulting participation from interested businesses, that will determine and define success for the eco-industrial park. Furthermore while corporate profitability and efficiency have led discussions regarding park design, similar efforts have been made to include environmental standards from the very start of the development process.

Another impediment to eco-industrial development are the existing policies and regulations that often contribute to staid and conventional industrial processes and systems. Complicated and without much flexibility, such a regulatory context does not readily support as yet 'untried' innovation including eco-industrial development and attendant industrial recycling. It is entirely conceivable that the Brownsville Eco-Industrial Park will apply for federal US Environmental Protection Agency *Project XL* designation in the near future. While the area has been traditionally very 'closed door' with respect to commercial innovation, the efforts of Commissioner Lockett have worked to build interest in the project despite the prevailing conservative nature of the fiscal environment. As a result, roughly 70% of local businesses surveyed appear willing to listen and consider participation in the eco-industrial park, while an additional 25 to 30% are exceedingly interested in becoming involved. Unfortunately, despite the original concept incorporating both cities across the United States-Mexico border, there has been limited involvement with the City of Matamoros in Mexico, largely because of lack of funding and other administrative oversight.

Despite difficulties in organizing efforts binationally, there is nevertheless hope that regional and local participation will eventually lead to an extension of the project across national boundaries.

Because of the relatively unpracticed nature of the eco-industrial concept, a basic plan is fundamental for industrial recruiting purposes. Despite Kalundborg, Denmark's unassuming evolution into a sustained and feasible eco-industrial park, similar developments necessarily require a distinct and convincing project plan to attract corporate interest and committed involvement -- especially given the regulatory framework presently in place in the United States. Appropriate planning and design tools to generate the requisite plan do not as yet exist however, frustrating and delaying the planning process even further.

Funding:

United States Department of Commerce: grant awarded to update and refine an industry database for the Brownsville area

Texas Natural Resource Conservation Commission: in-kind grant of staff for development of new regulatory approaches

City of Brownsville: in-kind grant

Port of Brownsville: in-kind grant

Partnerships:

Industry:

Bechtel Corporation

Local:

City of Brownsville: in-kind grant

Port of Brownsville: in-kind grant

Brownsville Economic Development Council

Public Utilities Board

Regional:

Maquiladoras and their related associations have been very useful in assembling the necessary data regarding industry input and output.

Border Information and Solutions Network

State:

Texas Engineering and Extension Service: in-kind grant for data collection, development of industry database

Texas Natural Resource Conservation Commission

National:

Environmental Defense Fund: contribution of staff scientist as consultants in process

President's Council on Sustainable Development

Federal:

United States Department of Commerce: in-kind grant

Academia:

Texas University at Brownsville

❖ **SKAGIT COUNTY ENVIRONMENTAL INDUSTRIAL PARK**

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Mission:

Skagit County harbors the expectation that environmental conservation and economic development are not necessarily contradictory principles. Indeed, especially crucial priorities for the county include: the encouragement of recycling and other green industries, protection of prime agricultural and resource lands, and the accommodation of sustainable economic uses which are compatible with environmental protection goals. The mission of the park therefore, is specifically to create and preserve employment, meanwhile protecting and enhancing the environment and quality of life in Skagit County. Given the very severe solid waste disposal issues presently constraining Skagit County, the Environmental Industrial Park is focused upon housing and encouraging recycling and other related environmental businesses. Five primary components will be incorporated into the Environmental Industrial Park: these include Recovery, Manufacturing, Community, Sales and Marketing, and Environmental Business Development Centers. The author recommends referral to the comprehensive *Skagit County Environmental Industrial Park Feasibility and Planning Study*, for more detailed analysis of the proposed project -- including presentations of financial and market feasibility.

Setting:

Skagit County is largely rural, with present heavy economic reliance on agricultural production. Composed of small towns, much of the area depended previously upon the success of timber and wood products industries.

History:

A demonstrated community concern for job generation, coupled with earnest development of recycling programs in the county since the early 1990s, has led directly to the establishment of the environmental industrial park concept. Indeed, the promotion of recycling and other related opportunities for environmental industries has been a demonstrated priority for both environmental and economic development agencies in Skagit County for the better part of this decade. The April, 1994 *Skagit County Comprehensive Solid Waste Management Plan (SWMP) Update* delineates an overarching goal of implementing a long-term approach to solid waste planning and management in the county -- the document explicitly incorporates a twenty-year planning schedule with attendant review every five years. In conjunction with the *Solid Waste Management Plan*, an *Overall Economic Development Plan* was instituted in July of the same year to define a comprehensive plan for economic growth throughout Skagit County over a twenty-year period. Furthermore, the *Overall Economic Development Plan* emphasizes natural resource conservation and protection of environmental quality through the diligent promotion of commercially- and environmentally-sound recycling businesses. Indeed, the *Economic Development Plan* calls explicitly for the planning and implementation of an environmental industrial park as one means of responding to both the solid waste and job generation issues. Consequently, the proposed environmental industrial park is a direct result of the county's success in attracting and expanding recycling companies in the immediate area: the park will build further upon this experience by targeting the recruitment of recyclable material processors and recycled product manufacturers. The Environmental Industries Program of the Economic Development Association of Skagit County was created in 1991 to highlight the relationship between community job creation and preservation and healthy environmental sustainability. Additionally, the Skagit Wetlands and Industry Negotiations process,

conducted in 1994 and 1995, has helped to reinforce the collaborative planning process in order to ensure dual objectives, economic development and wetlands protection. This project has incorporated participation from a wide variety of local, state and federal agencies, tribal governments, environmental organizations, commercial and development interests. The Economic Development Association has similarly investigated the feasibility of housing a wood products business incubator to address the needs of small forest products firms, as well as to stimulate timber-distressed economies prevalent in the eastern part of the county.

In 1994, the Economic Development Administration of the US Department of Commerce authorized funding for a comprehensive environmental industrial park feasibility and planning assessment. Conducted by a consortium of consultants, the feasibility report was reviewed periodically by three teams of stakeholder participants. On the first level, Economic Development Association of Skagit County staff maintained direct liaison with the consulting team; second, the Environmental Industrial Park Advisory Team representing local economic and environmental interests met four times over the course of the six-month study to provide input into the process; third, a Technical Advisory Group composed largely of regional and state technical expertise reviewed drafts of the feasibility study. An intensive survey was conducted among the residents of the county in order to solicit their evaluation of the area's most pressing needs. Results from the survey, in conjunction with an examination of waste audits conducted throughout the county, identified a pressing need to appropriately address recycling capability -- especially in wood, plastics, and organic materials. Located within an economically-impooverished area, the Economic Development Association of Skagit County began work in the 1970s, with job creation as a demonstrated focus. The steering committee of the association includes members of the Port of Skagit, the Center for a Clean Washington, local Port commissioners, representatives of the environmental community, Solid Waste Advisory Committee, and the Vintage Oil corporation. The Skagit County Environmental Industrial Park utilizes a public-oriented approach in forming priorities and implementing decisions.

Present Activity:

Without doubt, the county is presently experiencing urgent solid waste disposal problems that demand immediate attention and innovative solutions, given the lack of accessible landfill space and defunct incinerator. As a direct consequence, this especially critical issue largely drives corporate interest, motivation and participation in the environmental industrial park concept. The acknowledged foundation for the Environmental Industrial Park will be a collection of recycling-based industries: including outlets for marketing, development and retail sale in the area. Corporate interest in the development has consistently been quite high, as evidenced by the encouraging results of a market research survey conducted (approximately 80% of all respondents). Indeed, the project team notes that the original concept of the environmental industrial park has been relatively more easy to sell than the actual siting of the development itself!

Future Objectives:

A current priority for the Skagit County Environmental Industrial Park is the collection of funds for continued development of the park. While considerations involving site location and contingent infrastructure have been resolved most recently, it is imperative for the project team that the momentum concerning further investment in the park continue to build. Particular effort will be targeted towards recruiting long-term commitment from industry and public officials in the near future.

Barriers:

A significant barrier to the development of the Environmental Industrial Park has been political willpower -- the largely conservative county council is more than a little reluctant to support a venture previously untried. Furthermore, the project team has been frustrated with current fundraising efforts. All too often, foundations and other funding agencies are interested only in

financing new and innovative projects on a superficial level: ongoing projects that require farsighted planning appear unfortunately, considerably more difficult to promote. Critical questions surrounding the funding of capital and continuing costs of operation threaten to hamper progress on the environmental industrial park site. Potential problems include environmental and infrastructure issues: including those of possible soil contamination, and the capacity of existing wastewater treatment facilities to accommodate the heightened demand for services. Furthermore, while concerns regarding permits or regulations may be as yet premature for the Skagit County Environmental Industrial Park, added incentives for promotion of the park may be entirely unnecessary: the most reasonable, dependable motivation attracting willing businesses continues to be reliance upon the profit margin.

Of paramount importance to the eco-industrial process overall, is the timely development of an inventory of local needs -- indeed, this provides the critical base upon which to build all future endeavors. In the same way, public perception may be detrimental to a park if the larger community has not been invited to participate in the process of shaping the concept to suit local needs. Of equal necessity, partnerships must be accurately gauged for depth of commitment, including those with both public and private agencies.

Funding:

Northwest Area Foundation: for the development of the project
EnviroCenter: for in-kind grant of environmentally-friendly merchandise
Center for a Clean Washington: in-kind grant for market research and development needs
United States Department of Commerce:
Economic Development Administration: \$45,000 for feasibility study

Partnerships:

Industry:
Vintage Oil

Local:

Economic Development Association of Skagit County
Port Commission
Skagit County Board of Commissioners
Skagit County Public Works Department
Skagit County Solid Waste Department
Solid Waste Advisory Committee

Regional:

Center for a Clean Washington: market research and development needs
Northwest Area Foundation

State:

Recycling Association
Washington Department of Ecology
Washington Department of Economic Development

National:

Federal:

United States Department of Commerce:
Economic Development Administration

Academia:

❖ PORT OF CAPE CHARLES SUSTAINABLE TECHNOLOGIES INDUSTRIAL PARK

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Mission:

Northampton County and the City of Cape Charles are committed to facilitating an excellent business environment, in strict companionship with both a pristine natural environment and an exceptional living environment. Furthermore, both county and city seek development that is productive for business, respectful of the environment and positive for the area's residents. Indeed, a healthy and sustainable economy for Northampton area residents is one that protects natural, cultural and historic assets for current and future generations, one that fosters a respectful and attentive environmental regard. Furthermore, sustainable development in Northampton County is proudly focused not simply upon philosophy, but upon action: effective investment of resources that is comprehensive in its scope and objectives -- addressing social equity, job generation, and environmental conservation issues.

Setting:

Located along a 100 mile stretch of the Chesapeake Bay, Northampton County is composed largely of rural villages and towns; productive land that is rich environmentally and culturally, if economically more impoverished. The City of Cape Charles is the largest town on the Chesapeake Bay and is located at the southern tip of Virginia's Eastern Shore.

History:

The Cape Charles Harbor was recommended in May of 1994 as the most promising site for a county-wide industrial park: in turn a natural extension of the county-wide effort, the proposed *Sustainable Development Action Strategy*. The Strategy, created in May and later adopted in June of 1994 by the Board of Supervisors, is a document detailing a comprehensive economic development and resource conservation program for the entirety of Northampton County. Furthermore, the Action Strategy was recognized by the National Association of Counties with the Presidential Leadership Award as a model for sustainable development of local communities throughout the nation.

In August of 1994, the Port of Cape Charles was selected as one of four national demonstration projects of the President's Council on Sustainable Development. While affiliation with the President's Council has not resulted in project funding per se, such national recognition has nevertheless been exceedingly valuable for public relations and reinforcement purposes. An Industrial Park Task Force was formed in September, while a *Resolution of Commitment to the Port of Cape Charles Sustainable Technologies Industrial Park* was adopted by the Town Council with the Board of Supervisors to pledge mutual support in December of 1994. The Town Council and Board of Supervisors hosted a two-day site conference of the President's Council on Sustainable Development in early February, 1995 and included the participation of some 67 demonstrated project partners from a wide variety of sectors.

Simultaneously, the Town Council and Board of Supervisors hosted a Community Design Workshop and Charrette as the formal initiation of the industrial park project for the community at large. More than 200 local citizens were engaged in designing the future shape and uses of the park, including the participation of some 150 local residents, property owners, prospective businesses and investors, and the professional Design Team of industrial architects, designers, engineers and business developers. A design charrette for facilitation of the Master Plan occurred in April of 1995 -- the final document, *Conceptual Master Plan for the Industrial Park*, was endorsed by both the Board of Supervisors and the Town Council as the *Industrial Park Master Plan* in June, 1995.

In August of 1995, the first corporate tenant, Solar Building Systems, Inc. of Bern, Switzerland, announced its commitment to locate at the park site. The company is presently working out of temporary facilities, having created a number of new jobs for local residents. Following a public hearing, the Cape Charles Planning Commission recommended rezoning of the development site to become a Sustainable Technologies Industrial Park (STIP) Zone, including rezoning of land around the harbor -- the recommendation was adopted in January, 1996. The Port of Cape Charles Sustainable Technologies Industrial Park intends to recruit non-polluting and resource-efficient businesses which will build upon the immense environmental and cultural wealth of the area; six broad industry categories and resource streams were chosen as targets which are particularly fitting for the county.

Present Activity:

Currently, while the land for the site has been contracted, closure is nevertheless still pending: purchase of the land will be covered jointly by state and federal funds. Some \$2.6 million dollars in funds have been committed for completion of Phase I of the project, though funds for the remaining phases remain outstanding. In addition, the Northampton County Sustainable Development Initiative will focus particular attention to addressing economic development issues -- including further exploration of the explicit connections between job generation and natural resource preservation. Creating sustainable living-wage employment for area residents, and otherwise addressing other pressing economic development concerns, is a present task that will be more fully explored in the coming months.

Future Objectives:

As the construction document was only recently completed -- a bit tardier than expected, ground breaking at the industrial park site is planned for September of this year. Moreover, Phase I development of the site is projected to extend until September, 1997.

With the realization that industrial ecosystems are designed over time, with each piece added singly, the Port of Cape Charles Sustainable Technologies Industrial Park is intent on first developing an effective overarching framework and the accompanying guidelines for incorporating each piece. While three businesses have been recruited as willing participants in the eco-industrial park (Bayshore Concrete Products Corporation, Eastern Shore Railroad, Inc. and Solar Building Systems, Inc.), the integrated implementation of industrial ecology principles has not yet been determined. More intensive coordination of the individual components of the eco-industrial development is an important next priority for the Northampton County Sustainable Development Initiative, including identifying appropriate tenant matches for materials exchange. Local business Bayshore Concrete Products Corporation for example, utilizes a great deal of water during production -- the possibility of using water recycled from the waste recovery plant, perhaps even incorporating neighboring wetlands as a natural filtration system, are currently being considered. An additional number of potentially-effective industrial applications include targeting: the food service industry to reuse elements from the waste stream, connections based upon the use of water in order to better preserve groundwater supply and quality, and the recycling of energy use.

An environmental business incubator component is also presently being discussed: one that will perhaps include food processing and the development of other locally-owned sustainable products. A formal business plan for the business incubator aspect of the project is expected to be completed by November of this year, including close examination of business support services that may be offered to potential tenants.

Barriers:

One challenging aspect of developing eco-industrial systems is the scattered availability of pertinent information. With multiple parks being designed across the nation, some cooperative access to joint inventories, directories and other databases would be profitable for all stakeholders involved. In this way, the President's Council on Sustainable Development has been highly valuable for drawing a broad-based variety of resources and investment possibilities to the Port of Cape Charles Sustainable Technologies Industrial Park. Furthermore, while certainly not a barrier to development, the interdisciplinary nature of designing eco-industrial systems and incorporating the appropriate processes (financial, cultural, social and environmental) is neither entirely straightforward or necessarily obvious. Indeed, as much or more planning is required to facilitate the thoughtful inclusion of each major stakeholder group to reach eventual consensus, as for the actual implementation of the subsequent design and action plans. Investment in the process of achieving community, industrial and environmental ownership of the proposed project is likely as significant an indicator of future 'success' as more quantifiable commitments of concrete resources and funding.

Funding:

Virginia Department of Conservation and Recreation, Virginia Coastal Program/National Oceanic and Atmospheric Administration: commitment for \$65,000.00 to fund the Master Plan design for the park

United States Department of Commerce:

Economic Development Administration and \$400,000.00 committed for Phase I infrastructure construction

United States Department of Agriculture:

Rural Economic & Community Development Services: jointly commit \$1,067,000.00 for Phase I construction of infrastructure

United States Department of Agriculture: \$390,532.00 pledged for Phase I infrastructure construction

Board of Supervisors of Northampton County: guarantee \$267,000.00 in matching funds for federal financing package for Phase I construction of infrastructure

United States Environmental Protection Agency: awards \$200,000.00 as a national Brownfields Economic Redevelopment Pilot project, for use in engineering design, environmental cleanup and development of harbor area phases

Board of Supervisors and Virginia Department of Transportation: \$340,200.00 from Virginia Secondary Road Program for road improvements

Eastern Shore Resource Conservation & Development Council: \$7,600.00 for construction of visitor pavilion

United States Department of the Interior, Fish & Wildlife Service: awards substantial National Coastal Wetlands Grant (through the Virginia Department of Conservation & Recreation) for acquisition of the Coastal Dune Habitat Preserve and other natural area components of the park.

Northampton County: \$500,000.00, in-kind donation of staff time and office space

Virginia Department of Transportation, Department of Environmental Quality, and the Department of Conservation and Recreation: \$400,000.00

United States Department of Agriculture: \$490,000

United States Department of Commerce (Economic Development Agency): \$400,000.00

United States Environmental Protection Agency: \$200,000.00 for brownfield redevelopment

National Oceanic and Atmospheric Administration: \$146,000.00 for planning and \$85,000.00 for construction of a boardwalk dune crossing to initiate conservation of the coastal dune preserve
United States Fish and Wildlife Service: \$800,000.00 for purchase of a coastal dunes parcel for inclusion into an on-site preserve
Bayshore Concrete Products Corporation: donation of adjacent land parcels for inclusion into coastal preserve

Partnerships:

Industry:

Bayshore Concrete Products Corporation
Brown & Root, Inc.
Eastern Shore Railroad, Inc.
Solar Building Systems, Inc.

Local:

Cape Charles-Northampton Chamber of Commerce
Citizens for a Better Eastern Shore
Citizens for Social Justice
Concerned Citizens of Cape Charles
County of Northampton
National Association for the Advancement of Colored People
Northampton Branch
Northampton County Schools
Northampton County Sustainable Development Task Force
Town of Cape Charles

Regional:

Accomack-Northampton Planning District Commission
Eastern Shore of Virginia Chamber of Commerce
Eastern Shore of Virginia Economic Development Commission
Eastern Shore of Virginia Resource Conservation & Development Council
Economic Development Advisory Council -- Region 18
Virginia Eastern Shore Economic Empowerment and Housing Corporation

State:

Division of Natural Heritage
Opportunity Virginia
Virginia Coastal Program
Virginia Department of Conservation & Recreation
Virginia Department of Economic Development
Virginia Department of Environmental Quality
Virginia Department of Housing and Community Development
Virginia Department of Transportation

National:

Environmental Concern, Inc.
Institute for Local Self Reliance
National Association for the Advancement of Colored People
National Association of Counties
President's Council on Sustainable Development
The Nature Conservancy

Federal:

Economic Development Administration
National Oceanic and Atmospheric Administration
National Park Service
Rural Economic and Community Development
United States Army Corps of Engineers
United States Coast Guard
United States Department of Agriculture
United States Department of Commerce
United States Department of Energy
United States Department of Interior
United States Environmental Protection Agency
United States Fish & Wildlife Service

Academia:

Eastern Shore Community College
Northampton County Schools
Rural Policy Research Institute
School of Architecture
School of Environmental Sciences
University of Virginia
Virginia Coast Institute
Virginia Polytechnic Institute & State University

❖ CIVANO, TUCSON SOLAR VILLAGE

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Office of Economic Development
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Tucson, Arizona 85726-7210

Mission:

Civano is the result of extensive cooperation by local and state government, the development community and environmental groups to create a sustainable community based upon dynamic synergistic relationships. Named after the native Hohokam's golden era of civilization -- one which maintained a harmonious interdependence between the natural environment and human needs, Civano will be a place where both natural and manmade environments coexist. Specifically, it envisions a community in which energy and water use, pollution and solid waste, and other environmental impacts are all significantly reduced. Beyond the ecological benefits moreover, Civano promises to create an affordable, sociable neighborhood in which its inhabitants can live, work, recreate and enjoy a high quality of life. The *Civano Master Plan* defines seven environmental performance standards which are the primary foundation of the Civano vision. These standards, as based upon the City of Tucson's baseline conditions, are as follows:

- Energy demand reduced by 75%
- Energy supply increased by use of solar generation
- Water use reduced by 65%
- Solid waste reduced by 90%
- Air pollution reduced by 40%

- Creation of one job for every two housing units
- Design, construct and market housing for affordability

The Civano Master Plan calls specifically for innovation in meeting performance targets. As a result, energy demand will be reduced by improving structures' shells, attendant heating and cooling systems, and by designing streets, lots and exterior spaces to minimize energy needs. Energy supply will be increased by partitioning land specifically for the purposes of solar photovoltaic and thermal power generation, as well as incorporating solar equipment into structures. In order to reduce water use, reclaimed water will be used within Civano for irrigation and landscaping, while structures will include water efficient fixtures and water recapture systems. Solid waste will be reduced by creating a recycling/composting center, building recycling separation areas into individual residences as well as the extensive use of recycled building materials. Similarly, air pollution will be reduced through incorporation of commercial services into the development itself - thereby eliminating the necessity of vehicle use. Civano will further limit air pollution by creating a walking and bicycling path throughout the community and extending bus or shuttle service to the area. As Civano is constructed, employment will keep pace with residential development at a rate of one job per residence, further reducing the need to commute and increasing the sense of community. Finally, homes will be moderately priced in order to allow employees to live in close proximity to their place of work.

In order to meet the established standards, the City of Tucson has provided strict guidelines for the master developer and builder. The guidelines incorporate the conditions attached to zoning approval for the project and are designed to direct the city as it reviews development plans and permit applications. Furthermore, for each of the resource efficiency goals established for Civano, specific technical requirements, implementation and monitoring responsibilities have similarly been set. The master developer and builders will assume the primary role in realizing the resource efficiency goals, although the City of Tucson will continue to take a very active role in the development of Civano, as will various state and local agencies. Finally, the Civano Community Association, a non-profit corporation, will be created to implement some of the specific requirements and monitor builder compliance to the guidelines.

The planning team responsible for designing Civano has employed innovative land use and development methods to realize a vision of a sustainable community that benefits both its residents and the environment at large. Of particular significance with regards to the Civano development have been respect for the desert ecosystem surrounding Tucson, and the encouragement of interaction among Civano residents. The design for the site includes extensive open space - which will remain undeveloped to allow wild flora and fauna to flourish, while planned parks and walking and bicycling paths are integrated throughout. Additionally, streets will be narrower, encouraging more social interaction among area residents, and lined with shade trees to create a cooler microclimate. Civano's residential areas will be designed as neighborhoods in a more traditional sense. These will surround a village center, which will contain commercial, civic and cultural facilities. Finally, residents will be encouraged to find employment close to home in industries and business recruited by regional and state economic developers.

Setting:

Located on the outskirts of the City of Tucson, Civano is located in a highly desirable and rapidly growing urban area: a promising region rich in natural and economic amenities. Indeed, Tucson's metropolitan population has grown annually at an average rate of 2.8% over the past fifteen years. Despite its demonstrated growth however, Tucson has remained affordable, and as it continues to attract dynamic industries (including technology and software development), the economic outlook for the area is strong. Finally, if reasonable cost of living and good employment prospects are not enough of a selling point, the Tucson area enjoys approximately 350 days of sunshine per year, attracting tourists who spend upwards of \$2 billion there annually.

History:

A model sustainable community poised for development in southeastern Tucson, the Civano project grew out of a well-received showcase of homes featuring solar design. In 1999, Civano's project team conducted a market survey among residential and business consumers to determine the level of interest in the project's development standards. Some 58% of residential respondents commented that a community like Civano had "a great deal of appeal," while 36% said it had "some appeal." Furthermore, 45% of business consumers found the Civano concept greatly appealing. After noting the enthusiastic builder and consumer response to the solar homes, the Metropolitan Energy Commission, local builders and environmental activists persuaded the Arizona Energy Office to fund Civano's planning and design. The City of Tucson granted the necessary planning and zoning approvals to turn 820 acres of state land into a "neo-traditional" community encompassing open space, businesses, cultural amenities and some 2,300 homes and apartments. Eventually, Civano will accommodate 5,000 area residents.

Present Activity:

Prospective master developers are being required to submit bids beginning at \$2,310,000.00 -- the appraised value of the property. Further design review and planning will next occur, with installation of infrastructure slated for January of 1997. The projected grand opening of the Civano development is projected for July of 1997.

Future Objectives:

Barriers:

One particularly severe impediment to timely establishment of Civano, has been the demonstrated economic disincentives to developing the project given the accompanying stringent performance standards. In order to make the project more attractive and to encourage future sustainable land use and development, the City of Tucson has created an extensive support program for the project. In addition to emphasizing a low-appraised value of the land, this program includes educational initiatives for all designers, developers and builders who participate in the project. Furthermore, the city has undertaken the role of aggressive promoter and marketer of the development: indeed, emphasizing its sustainable standards in advance of the start of actual construction. To augment the incentives mentioned above, the city has also suggested it will consider other benefit options, including 'fast-track' processing of plans and permits; extension of the city's reclaimed water main to the site; and provision of tax-exempt bonding for funding of infrastructure. Additional incentives may be negotiated between the master developer and the city, and later incorporated into a binding development agreement.

The appraised value of the land reflects the costs involved in meeting the stringent sustainability goals established by the City of Tucson, in connection with its grant of planning and zoning approval. The relatively low-appraised value further acknowledges the marketing limitations inherent in the untested nature of Civano's village design and resource conservation features. Civano's promoters are optimistic however, that the low-appraised value will counterbalance the market risks and costs of implementing Civano's innovative design.

Funding:

Partnerships:

Industry:

Local:

City of Tucson, Office of Economic Development

Regional:

State:

National:

Federal:

Academia:

❖ SOUTH CENTRAL BUSINESS DISTRICT

Main Contact:

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Chattanooga, Tennessee 37402

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Riverfront - Downtown Planning - Design Center

Second Floor -- Miller Plaza

850 Market Street

Chattanooga, Tennessee 37402

Chattanooga-Hamilton County Regional Planning Commission

200 City Hall Annex

Chattanooga, Tennessee 37402

Mission:

Simply one component in a vast and comprehensive plan for the revitalization of the City of Chattanooga as a whole, the South Central Business District is a section of the Chattanooga downtown area slated to become one of four potential eco-industrial parks. Other major projects currently being considered for this area include: expansion of the Trade Center, Warehouse Row, and the Tennessee Valley Authority (TVA); construction of a stadium, a parking garage capable of accommodating 500 vehicles, a zero-emissions industrial facility, and an executive conference and training center. Representatives from each of these projects will participate with consultants, city planners, RiverValley Partners and other stakeholders to develop an appropriate blueprint for the redevelopment of the South Central Business District. Indeed, a vital South Central Business District should be one location where people can live, work and play in a safe and positive environment. The author recommends perusal of *A Comprehensive Revitalization Strategy: The South Central Business District Plan* available from the RiverValley Partners for more detailed information regarding the proposed project.

Setting:

Several projects representing major investments in this district are currently underway, or on the drawing board in the conception stages. The area is defined by 12th Street to the north, I-24 to the south, US 27 to the west, and Market Street to the east. The potential opportunities to reenergize this part of the downtown community to economic productivity are indeed tremendous: these opportunities can be fully realized however, only through careful planning and integration of all interests.

History:

A city with a rich heritage in manufacturing, Chattanooga has faced virtually the full spectrum of associated economic and environmental problems of this century. During a period of the 1960s, Chattanooga was ranked as having the worst air quality in the country and indeed, was given the epithet of "worst polluted city" in 1969. Furthermore, some of the earliest urban air quality studies of the 1970s were conducted in the City of Chattanooga. In addition to fighting the traditional urban concerns of particulate matter of smog (ozone), Chattanooga also experienced significant problems associated with high concentrations of nitrogen dioxide.

Yet almost thirty years ago at the height of national industrialization, the city established environmental quality as a major priority for the future. Because of the grave magnitude of the problem, residents of Chattanooga -- including private, public and industrial sectors -- united to combat pollution, as well as tackle the negative city image created by the serious air pollution problems experienced. As a response, Chattanooga developed a regulatory program twenty years ahead of its time; indeed only with the recent passage of the Clean Air Act Amendments of 1990, have federal requirements caught up with the program implemented in Chattanooga in the early 1970s. The results achieved through these locally-developed air quality regulations have been a source of pride and an improved environment to the city: indeed, Chattanooga is committed today to becoming the most environmentally-attentive mid-sized city in the country.

Historically, the city of Chattanooga's South Central Business District was dominated by a mixture of industry and housing. Eventual decline of the urban core in recent decades however, due to industry closure or relocation, has resulted in economic depression for large sections of the central city. Indeed, the remaining housing stock in the South Central area is in a very deteriorated condition. Despite the blighted condition of this district, the supporting infrastructure -- streets, sidewalks, and utilities -- remains intact. Indeed, recycling the existing land and infrastructure for new, economically-viable and ecologically-responsible uses is the paramount challenge facing the city. This concept of "eco-efficiency" implicitly includes issues of vital interest to industry, local governments, and citizen groups as well.

Present Activity:

Eco-Industrial Parks and Brownfield Redevelopment

The public expects a clean environment and demands high quality goods and services. To achieve a sustainable industrial life cycle and a clean environment, new ways of looking at old problems must be developed. Unlike many of our neighbors throughout the south, Chattanooga has long been an industrial community therefore experiencing problems similar to our northern industrial cities. In order to achieve sustainability in goods, services, and the environment, Chattanooga has turned its attention to redeveloping former industrial properties, many of which have been moderately contaminated in the past. This concept is sometimes referred to as industrial property recycling or brownfield development. As one aspect of present eco-efficiency efforts, Chattanooga is staking out a leading edge position on redeveloping contaminated properties.

To maximize these opportunities, a major planning effort for the South Central Business District was held October 11th through the 13th, 1994: the catalyst for this study was the Trade Center's interest in

an integrated study as part of its expansion planning. In turn, this interest provided the necessary opportunity to examine the larger, overarching context of the South Central Business District.

This unique approach to community planning will integrate current and potential projects in a flexible plan which will enhance the commercial, social, public and environmental aspects of this area. The study will be conducted by Peter Calthorpe, a nationally known authority on urban planning and William McDonough, an architect at the forefront of environmentally-sustainable design. A three-day charrette will include participation by an interdisciplinary team of professionals working alongside major stakeholders in the project.

Industry Initiatives

Public sector initiatives to revitalize old or abandoned manufacturing sites have been joined by numerous projects undertaken by private business. The one selected for highlighting at this time is at the W.R. Grace plant in Chattanooga. W.R. Grace & Company has exhibited a continuing strategic commitment to the environment and local economy by a voluntary capital investment of \$15 million in a recovery and storage project for commercially-valuable rare earth and low-level radioactive material. Further expenditure of \$6 million in additional capital and \$12 million in operating costs over the ten year life span of the operation are projected. The project is unique for its sensitive handling of several vital objectives: environmental restoration, preservation of jobs, involvement of community leadership and citizenry in decision making, and the production of a future energy resource.

Energy and Transportation:

- Advanced Vehicle Systems
- Electric Transit Vehicle Institute
- Electrotek
- Energy Vision 2020: TVA'S Long-term Energy Strategy
- Trade Center Expansion
- Intermodal Passenger Train Facility
- Transportation Steering Group

Natural Resources:

- Chattanooga Creek
- North Chickamaunga Creek
- Groundwater Resources Protection Program
- Stormwater Management Program
- Tennessee River Gorge Trust
- Tennessee Riverpark and Greenways System
- Chip mills

Sustainable Agriculture:

- Biomass Energy Initiatives
- Watershed Improvement Initiatives
- Waste utilization, improved fertilizer, and pesticide management

Community Participation/Affordable Housing:

- Chattanooga Venture and the Community Vision Process
- Downtown and Riverfront Revitalization
- Chattanooga Neighborhood Enterprise

Industry Initiatives and Eco-Industrial Parks:

- Air quality

- South Central Business District Eco-Industrial Park
- W. R. Grace Sediment Recovery Project

Population and Consumption:

- Orange Grove Materials Recovery Facility
- Harriet Tubman Express

Future Objectives:

Revitalization of the entire City of Chattanooga both economically and environmentally is the overarching objective of development efforts in the city. Broad-based comprehensive plans for the area are impressive in their scope, and include some six sub-area plans. In addition, planned "catalyst" or secondary projects are expected to continue and reinforce the momentum of development investment into the future. The outcome of these planning and redevelopment efforts must go beyond "environmental" industries to include a broad range of economic, employment and housing opportunities for the local citizenry.

Barriers:

Multiple ownership of the land, current zoning and building codes, environmental remediation costs and available financing mechanisms all present significant barriers that must be overcome in order to achieve the goal of revitalizing the City of Chattanooga. One particular strength of the Chattanooga process for redevelopment of the city has been the immense volume of input garnered from the communities themselves. Indeed, when citizen participation is not a demonstrated priority for the development process, future ownership of the project may quite likely be compromised at a later date. The extraordinary range of challenges faced by the communities involved reflect the diversity of issues inherent in the planning and implementation processes, and should consequently be respected as such.

Some significant observations gathered to date include the fact that the majority of manufacturing and office candidates search specifically for an existing building or a qualified site: those locations that do not provide the requisite real estate conditions are therefore not considered. In addition, the project team has discovered that industrial relocation and expansion decisions are implemented within a relatively short space of time -- new facilities are sought usually between six and fifteen months of the initial decision to relocate or expand. In addition, given the truncated time frame, industrial parks recruiting new tenants must therefore be flexible enough to accommodate pressurized schedules, and otherwise provide the needed services for urgent requests. Finally, there seems little debate over the critical importance of establishing comprehensive permitting procedures that facilitate immediate set-up and operation for companies interested in locating on site. Not only does this form of permitting save start-up time for compressed schedules, it also works to encourage overall innovation in regulatory compliance; perhaps providing a useful context for regulating future waste and other materials exchange between businesses.

Funding:

Partnerships:

Industry:

Local:

RiverValley Partners

Regional:

State:

National:

President's Council on Sustainable Development

Federal:

Academia:

Section II. Eco-Industrial Park Developments Spreadsheet

The three spreadsheets are organized by primary, secondary and tertiary contacts respectively; individuals personally contacted are designated by italic script. Please note that Table 2 is largely incomplete as a number of eco-industrial developments were referenced to the author after the initial survey and preceding drafts of the report were already completed. The additional projects are listed simply for the reader's interest and for future reference.

Section III. Recommendations for Future Consideration

While each of the nine eco-industrial park developments documented in this report are the product of highly varied contexts and situations respective of specific locations, there are nevertheless a number of significant common threads joining them. Similarly, while only the oft-cited eco-industrial park development in Kalundborg, Denmark is fully operational at the present time, there are nevertheless essential lessons to be learned from observing the respective planning processes and transpiring conceptual stages of the many North American developments in their impressionable infancy stages. Over a fifteen year period, Kalundborg Park evolved essentially 'spontaneously' through the tireless efforts of entrepreneurs who recognized opportunities to transform waste products into marketable goods while reducing attendant costs, within the context of the current, resource-oriented regulatory climate. Indeed, although this first eco-industrial development gradually became established -- the direct result of a series of bilateral agreements between businesses located in the near vicinity, industrial ecology experts nevertheless acknowledge the importance of advanced planning and formal processes to inaugurate the concept in the United States. To this end, this document attempts to observe a handful of known projects, to recognize major stakeholders in the process, and to ascribe some guiding principles for similarly interested individuals and organizations in developing eco-industrial parks in local communities throughout North America in the near future.

Of striking significance is the observation that the majority of eco-industrial park developments surveyed are essential elements of a larger plan; the overarching framework often encompasses a greater geographic area or demonstrates more ambitious goals than the eco-industrial park itself. Indeed, eco-industrial parks like those planned for downtown Chattanooga's South Central Business District and Northampton County, Virginia, are simply components of a wider, more comprehensive strategic plan: the former for the revitalization of its inner urban core, the latter to acknowledge and complement the tenets of sustainable development for the county at large. Furthermore, it is often in this broader context of future objectives that draws the community directly into active participation in voicing needs and forging goals. Indeed, for a handful of these parks, the discussion prompting realization of the respective eco-industrial project was largely the work of motivated residents seeking realistic solutions to pressing social concerns. The Skagit County Environmental Industrial Park is one such graphic example of a development project fueled primarily by the citizenry at large: Kevin Morse, of the Economic Development Association of Skagit County, stresses the critical importance of directly addressing local needs. While inclusion of the project into a larger objective is perhaps self-evident, such partnership between the eco-industrial development and more expansive community goals must *not* be underestimated -- indeed, attention to the issues at the forefront of local environmental and economic consideration is necessary for long-term success of the eco-industrial park concept.

Continuing the vein of matching development projects to demonstrated local needs, Dr. Edward Cohen-Rosenthal, Director of the Work and Environment Initiative at Cornell University, places a great deal of emphasis on assessing conditions respective of the particular locale as fundamental to the planning process. Indeed, eco-industrial park developments should augment and complement the existing resources of a given community: not only those aspects indicative of corporate or commercial investment but especially those of environmental, cultural, and social or historic value. Most reasonably, full ownership of the industrial park development hinges on its accurate reflection of the stakeholders' various intertwining and interdependent values. Given the definitive connection between the site and the resulting development, careful investment in a meticulous and comprehensive feasibility or baseline study is critical for establishing a focus and maintaining priorities. The in-depth scenarios proposed by the Research Triangle Institute and Indigo Development's *Eco-Industrial Park Case Study* of Brownsville, Texas is based primarily upon prevailing local conditions, including the industries currently in place and those designated likely future tenants. While recognized priorities shape the direction and dimensions of the corresponding baseline study, the study itself is vital for documenting the local economy, environment, and community -- including both acknowledged assets and deficits. Again, while critical assessment of local conditions is perhaps an obvious step in accurately evaluating

resource availability, its critical significance to the development of eco-industrial parks necessarily mandates its early and fundamental incorporation into the process.

Another strongly-held recommendation among many project teams is that potential partners must be attracted to the development at an early stage. Ownership is gradually cultivated, established over time: fully-fledged commitment to the park necessarily depends upon ownership of the initial concept. Many of the nine developments emphasized attracting corporate interest *immediately*: as a profitable business venture, the eco-industrial park development must necessarily have firm supporters from commerce and industry to build credibility. Dr. Harry Janes, Director of the New Jersey EcoComplex, strongly advocates maintaining close relations with a motivated public official who will literally champion the industrial park to wider audiences as yet another critical asset. An innovative concept as yet untried in North America, the eco-industrial park development by definition unites formerly disparate perspectives together, wedding environmental sensibility with economic reality. As a result, while consensus among *all* participating stakeholders may appear unduly naive and idealistic, it is nevertheless a harbinger of eventual success for the eco-industrial park concept. Indeed, given industry's reliance upon demonstrated profitability and a favorable return on assets, there can be no underestimating the importance of drawing corporate input and investment into the eco-industrial development at an elementary stage. As ownership is neither automatic or immediate, ongoing public education and relations necessarily also accompany the eco-industrial development process quite closely. There is little doubt that much time and effort was -- and continues to be -- expended in focusing public attention on the projects surveyed for this report: broader awareness of both individual eco-industrial and corporate projects ushers in additional resources and facilitates possibilities otherwise unexplored. Sensitivity to the various barriers which currently face industrial ecology projects nationally is beneficial both as a public education exercise, as well as a means for introducing networking opportunities for interested agencies, organizations and project teams. Allocating resources toward encouraging and maintaining stakeholder relationships throughout the lifetime development of the project builds ownership and ultimately strengthens the viability of the ensuing project.

One aspect of attracting business partnerships that is of considerable significance is the importance of selling the industrial park development as an opportune and profitable endeavor, rather than as a strictly ideological enterprise. While cultivating and sharing a healthy regard for the larger environment is of obvious importance, potential tenants should nevertheless *first* be convinced of the financial feasibility of the development project. Long-term commercial association with industrial ecology precepts necessarily depends upon the economic viability of its application -- environmental 'goodwill' and sound intentions alone will not provide for the committed sustainability or widespread relevance of eco-industrial parks either in this country, or abroad. Furthermore, some form of incentive will likely be necessary to initiate the transformation from conventional industrial processes to those which embrace industrial ecology reform -- without an established precedent for eco-industrial parks in North America, the complicated risks involved with becoming a tenant in such innovative developments are necessarily greater than those for their traditional counterparts. Mutual dependence upon other firms to keep the integrity of the eco-industrial waste and resource exchange further complicates the commitment of any single tenant company: carefully-structured contractual covenants, liability declarations and the like, may help to balance out the otherwise weighty investments involved. State, local and federal agencies, in collaboration with private sources, may be able to cover heightened initial costs in order to induce participation by businesses otherwise hesitant to join local eco-industrial park development projects. In addition, resources including technical assistance and specific process expertise must not be undervalued: the US Environmental Protection Agency offers resources specific to eco-industrial parks through such programs as the *Common Sense Initiative*, the *Environmental Technology Initiative* and the *Environmental Finance Center*.

There is little doubt that the promise of economic return has often been juxtaposed against that of environmental preservation; this emerging consideration as a newly-fused and inseparable issue foretells much opportunity for creative redesign of both regulatory dictates and financial investment --

both locally and nationally. A regulatory framework based upon flexibility will help to offset the initial costs of involvement in an eco-industrial park by commercial entities. While stringent emissions standards and regulations regarding the use of toxic materials is obviously of great importance to ecological and conventional industrial developments, a more relaxed design for processing variances and other permits would allow businesses to gain from participation in an eco-industrial framework. The present Resource Conservation and Recovery Act (RCRA) regulations -- particularly Subtitle C -- are often cited by the project teams surveyed as one paramount barrier to materials exchange. More specifically, RCRA does not distinguish between solid and hazardous wastes and secondary materials that may be used as inputs into other processes. Indeed, reformation of RCRA permitting standards in order to facilitate the reuse of hazardous wastes is among the most critical regulatory concerns to be addressed before eco-industrial parks can become fully operational in the United States. Other related regulations shaping current industrial processes include: the Toxic Substances Control Act (TSCA) and the Toxics Releases Inventory (TRI), the Clean Air Act (CAA) and the Asbestos Hazard Emergency Response Act, the Clean Water Act (CWA), and the Comprehensive Environmental Response and Liability Act (CERCLA). The redefinition of substances more traditionally considered waste products is essential for building a regulatory environment conducive to innovative industrial design.

In response, one potential application for regulatory reform is the US Environmental Protection Agency's *Project XL*, which delegates much of the federal responsibility for environmental regulation to states and other local entities. The Project XL initiative grants regulatory flexibility to facilities, communities, sectors, and government agencies willing to demonstrate excellence and leadership in environmental protection -- an especially significant pilot project in the light of current industrial ecology initiatives. The New Jersey EcoComplex has created a series of interstate permits which are currently recognized and partnered by respective pollution regulation agencies in some ten states. Other possible approaches which might better promote the transformation from conventional industrial processes to eco-industrial development include: facility-wide, multimedia, consolidated, transferable or tradable permitting. Additionally, progressive international standards of environmental performance such as *ISO 14000* may further motivate companies interested in retaining a global share of their respective markets to be linked ecologically in full materials exchange. Indeed, as technology rapidly outpaces the limits of easy comprehensibility, eco-industrial principles may eventually be applied to worldwide industrial processes -- acknowledging manufacturing and commercial 'ecosystems' interrelated with and interdependent upon a host of economic, environmental, and social factors. Hardly a regulatory program by design, eco-industrial projects should nevertheless be granted some administrative flexibility both locally and federally in their pursuit of high environmental and economic standards of performance.

There is little doubt that the possibilities for tenant clustering are both sizable and largely unexplored; the criteria for defining potential tenant matches are a pressing concern for every eco-industrial project. In order to narrow the myriad possibilities in favor of local climes and regional commercial characteristics, many eco-industrial developments have created -- and periodically update -- databases of potential business and industry matches. These databases may offer a desired 'profile' of businesses best fitting the objectives of the project, or may catalogue the actual companies existing within a given geographical area of the industrial site, or may even list those businesses by standard industry codes (SIC) that have the best potential of being incorporated into an eco-industrial park setting. The Burnside Cleaner Production Centre for example, has specifically analyzed the following industries for their materials recycling and reuse potential: printing, vehicle maintenance, chemical, computer, electronics, metal finishing, and painting industries. The Brownsville Eco-Industrial Park is in the process of constructing a database that will feature some fifty industries specific to the site, as well as an additional one hundred generic businesses. Maintaining a current and accurate database of potentially 'fitting' companies is important both at the initiation of the project, as well as throughout the life cycle of the development. As echoed by a number of eco-industrial park planning teams, even with the plethora of easily-accessible information conveniently available today, blatant asymmetries nevertheless exist which block incorporation of industrial ecology precepts on a more widespread basis. Among the most serious

perpetrators of informational asymmetries is the fact that industries are bound to be protective of their respective processes and input requirements. Indeed, competitive advantage is often nearly synonymous with the successful containment of trade secrets, such that the rent captured through copyrighted status can be something of an oxymoron. Another impediment to materials exchange within a wider, inter-industrial setting is the tangible 'provability' of the industrial ecology concept: profitability as the demonstrated incentive for innovative economic pursuits still appears largely conceptual with regards to eco-industrial park development. Without an established record, businesses may be reluctant indeed to channel scarce resources and manpower to investigating exchange possibilities with neighboring facilities. Given the dearth of convenient and relevant information available to most companies interested in resource exchange and pollution prevention practices, ongoing educational campaigns aimed directly toward corporate stakeholders, as well as those targeting the general public, will be critical to the success of the eco-industrial park in any given locale. The viability and longevity of the marriage between economic and environmental performance must be articulated clearly to audiences invested in all aspects of eco-industrial development.

With regards to the specifications necessary for establishment of an eco-industrial park, experts currently agree that individually-participating industries do not need to be collocated to perform effectively. Indeed, veritable distance between tenant companies is not as vital a concern as precisely matching up the size and scope of participating businesses. Given the mutual dependence of any single business upon all others involved in the exchange loop, adequate 'back-up' reinforcement is crucial in the event of failure of any one business to provide the needed output materials to adjoining businesses. Furthermore, specialist Professor Gary Davis of the Center for Clean Products and Clean Technology expresses some concern that the rush to boldly implement 'closed loop' technology systems in the fevered attempt to create an eco-industrial park are perhaps more than a bit premature. He advocates an eventual build-up toward zero emissions, rather than artificially straining toward closed loop processes as an immediate goal from the very inception of the project. With few successfully established predecessors available for detailed observation and comparison, a single poorly-planned or inopportune eco-industrial development would likely jeopardize the broader overarching goals of the sponsoring community, in addition to deterring investment into similar developments in other locations. It bears noting once again that the eco-industrial park situated in Kalundborg, Denmark is the result less of organized intent, than the propitious circumstances of governmental pressure (in the form of regulation and incentive), coupled with the entrepreneurial willingness to innovate, and the additional boon of excellent timing.

In short, the following points are reiterated as numbering among the most significant aspects of an eco-industrial park development to carefully consider before the actual start of the project. While the highlights may appear self-evident and perhaps simplistic, their intrinsic causality to the success of a given industrial park development can not be overstated, nor should it be underestimated. For ease of organization, the concepts are divided into the following three categories: the strategic planning process, critical partnerships, and finally development practicalities. Furthermore, while none of the points necessarily supersede the others in relative importance, attention may be given them in the order given.

STRATEGIC PLANNING PROCESS:

- Engage in planning that encourages interdisciplinary participation and involvement -- visions that extend across formal and conventional boundaries.
- Invest generously in assessing the social, cultural, ecological, commercial resources and needs of the site or community at large.
- Maintain and periodically update a comprehensive database of all potential partners, those who fit a prescribed profile -- whether tenants or investors.
- Eco-industrial development should ideally be a single parcel of a larger, overarching comprehensive plan.
- Collect a diversity of committed stakeholders to jointly plan the development at the outset of the process.

PARTNERSHIPS:

- Gather a diversity of partners and funding sources to actively participate in the development and design process -- especially those with various technical expertise to offer.
- Begin forging firm partnerships with all stakeholders early in the development process; maintain committed relationships throughout progression of the project..
- Invest in public outreach and education on an on-going basis in all sectors: ownership of the concept is essential for effective future development and sustainable implementation.
- Cultivate motivated leaders who will champion the concept to wider audiences -- especially important are spokespersons in government, industry, and the community.

DEVELOPMENT PRACTICALITIES:

- Virtual eco-industrial park developments are certainly a valid possibility; collocation is not an essential characteristic.
- Zero emissions or closed loop processes may be built up as an eventual goal, rather than attempted as a first hurdle.
- Focus more attention on matching the size and scope of tenant industries at the start than on implementing closed loop systems.
- Utilize databases of industries to examine the compatibility of waste stream exchanges -- state, regional and national exchanges are similarly a possibility.
- Maintain networking relationships with similar eco-industrial projects: experience and perspective are exceedingly valuable assets to share.

Conclusion

While eco-industrial development is largely conceptual in the United States today, the idea nevertheless promises much in the way of innovation: a new approach to the conventional framework guiding commercial investment. Consequently, as the principles of industrial ecology gain firm ground in the active considerations of environmental and corporate interests alike, eco-industrial parks will similarly rise in prominence both nationally and abroad. Furthermore, as such parks are explored in greater detail and adapted to local conditions in a variety of settings, their dual objectives of natural resource conservation and economic viability will attract a broader base of stakeholders by nature of its interdisciplinary focus. In this way industrial ecology will not simply be a new arcane collection of technically-advanced processes and the accompanying expertise from increasingly-specialized fields of academic study, but a tacit recognition of the mutually-dependent forces shaping commerce, conservation and community at work today. Indeed, perhaps it is precisely this definition of ecology as a complex and interwoven plexus -- apparent in all aspects of life, that in turn lends itself most logically and generously to the implementation of sustainable development.

Even as the initial 'definitive' list of eco-industrial parks was completed earlier this summer, a host of additional sites were constantly being referred to the author. These include budding development projects such as the *Cabazon Resource Recovery Park* (located in Indio, California), *Nahar Eco-Industrial Park* (Punjab region, India), *Green Industrial Park* (Raymond, Washington), *City of Richland Master Farm Community* (Richland, Washington), and numerous others situated in Europe and Japan. As a result, the reader is reminded that this document serves only to provide a broad overview of present eco-industrial and environmental industrial park efforts in North America. Given the rapidity with which industrial ecology has risen to the forefront of sustainability discussions, much of the information included in this report has undoubtedly already been surpassed by more current material. This document was compiled with the intention of offering a general introduction to the eco-industrial park planning and implementation processes -- hopefully of use to both the well-versed and the uninitiated.

It is the author's sincere hope that eco-industrial park developments currently being established enjoy a most profound and public success. May the parks of the present and near future demonstrate the tangible feasibility and applicability of industrial ecology principles, tempting widespread audience participation in similar developments around the world. May the natural and human resources at work in industrial processes today come to realize the extraordinary benefits of close and intimate-cooperation with the assertions of sustainable development.

Appendix

Survey template for interviews of existing eco-industrial parks -- developed May 8th, 1996.
Question numbers highlighted in boldface are noted as being of special significance to the GREEN Institute.

1. What phase of operation and development of the site is currently underway? Is there current and/or background material available regarding your site that we might add to our library of resources?
2. Would you mind discussing your sources of funding (both potential and actual)? What parameters or constraints are expected to be critical in terms of future sustainability and profitability of the eco-industrial park?
3. What process is serving as the model for the eco-industrial park -- have you experienced any specific barriers to planning and development of the site? Is the eco-industrial park attempting to follow a "closed loop system" of production and appropriate re-use of wastes: if so, what institutions/industries are participating and how do they relate? Is the "zero emission principle" a demonstrated priority for the site: and if so, how?
4. Who first initiated the eco-industrial park idea at your site -- who were/are critical participants in the process of developing/implementing the idea? What role, if any, did/does the surrounding community/neighborhood play in ongoing planning and maintenance of the eco-industrial park? What kinds of integration and interface exist between the various surrounding commercial, residential, industrial, academic and governmental interests and the eco-industrial park site? What kinds of overall support and partnership have you received with respect to the eco-industrial park?
5. Have there been difficulties regarding adherence to specific zoning requirements? What was/is the original zoning categorization of your site and were negotiations necessary to allow actual siting of the eco-industrial park? Does the eco-industrial park visit the issue of "mixed-use" practicalities and how has that affected subsequent relations with zoning regulations?
6. How are tenants being recruited and what are some critical eco-industrial park priorities guiding this particular process? What sectors/industries feature prominently/predominately in your tenant recruitment process? Are there specific 'clusters' of businesses/industries that are of particular interest to your site? How were/are those clusters determined?
7. Are there any larger policy issues of note that your site has found to be especially significant in developing the eco-industrial park concept? Do you have any recommendations/suggestions to offer regarding obtaining and complying with the appropriate permits, waivers and city/regional/state/federal ordinances? Which were of particular importance with regards to establishing the site? Are/were there any regulatory issues of special concern?
8. Are there other individuals or organizations you could suggest as helpful references with regards to developing and implementing eco-industrial park plans -- anyone who was particularly helpful in developing your own site?

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Interviews:

Lucy Auster, Economic Planner
King County Economic Development Department
King County Office of Budget and Strategic Planning

Michelle Bell
Oak Ridge National Laboratory

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Hubert H. Humphrey Institute of Public Affairs
University of Minnesota

Professor Edward Cohen-Rosenthal, Director
Work and Environment Initiative
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Professor Raymond Côté
School for Resource and Environmental Studies
Faculty of Management
Dalhousie University

Professor Gary A. Davis
Center for Clean Products and Clean Technology
University of Tennessee, Knoxville

Christine Eustis
United States Department of Commerce
Office of Sustainable Development

Timothy E. Hayes, Executive Director
Northampton County Department of Sustainable Development
Joint Industrial Development Authority of Northampton County & Its Incorporated Towns

Professor Harry Janes, Director
New Jersey EcoComplex
Rutgers University

Rick Luna
Brownsville Economic Development Council

Sheila A. Martin, Senior Economist
Center for Economics Research
Research Triangle Institute

Kevin Morse, Program Manager
Environmental Industries Program
Economic Development Association of Skagit County

Internet Web Sites:

Site-Specific

Brownsville Eco-Industrial Park:

<http://www.tnrcc.state.tx.us/exec/baee/ba/ba1.html#2>

http://www.rti.org/hypo_etc/eco_indus.html

<http://www.triplesoft.com/bisn/ecopark.html>

Burnside Industrial Park:

<http://quasar.sba.dal.ca:2000/sres/BURN/home.html>

Cabazon Resource Recovery Park:

<http://www.sandersint.com/ecos/rrp.htm>

Civano, Tucson Solar Village:

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<http://ag.arizona.edu/OALS/ALN/Clark.html>

Duwamish Corridor Project:

<http://www.pan.ci.seattle.wa.us/business/dc/>

Fairfield Eco-Industrial Park:

<http://www.cfe.cornell.edu/wei/>

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Nahar Eco-Industrial Park:

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Skagit County Environmental Industrial Park:

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Section II. Directory of Eco-Industrial Park Development

Table 1A. Existing Eco-Industrial Parks (Contacted)

Development Site:	Contact(s):	Title:	Telephone:	Organization:	EIP Location:	Mailing Address:
Fairfield Eco-Industrial Park	<i>Ed Cohen-Rosenthal</i>	Work and Environment Initiative Director	#(607)255-8160: #(607)254-5089: #(607)255-0574: WEI Fax	Cornell University Oak Ridge Natl Labs & UT Center for Clean Products and Clean Technology	Baltimore, Maryland (Rochester, New York)	Cornell University PEWS / NYSSILR Work and Environment Initiative 105 Rice Hall Ithaca, NY 14853-3901
	(Don Hunsacker) (Tad McGalliard)	Project Manager				
South Central Business District (also: The Volunteer Site)	Judy Britain	Dir of Marketing and Research	#(423)265-3700	RiverValley Partners, Inc.	Chattanooga, Tennessee	RiverValley Partners, Inc. One Central Plaza, Suite 500 835 Georgia Avenue Chattanooga, TN 37402
	Robert C. Taylor, Jr. (Sid Saunders)	Urban Design and Project Development Consultant	#(423)266-5948 #(423)266-2757: Fax			
Brownsville Eco-Industrial Park	Jackie Lockett	City Commissioner	#(210)546-1161	City of Brownsville	Brownsville, Texas	Brownsville Economic Development Council 1205 North Expressway Brownsville, TX 78520
	Rick Luna		#(210)541-1183	Brownsville Econ Dev Council	(Matamoros, Mexico)	
Burnside Industrial Park	<i>Raymond Côté</i>	Professor	#(902)494-3632 #(902)494-3728: Fax	Dalhousie University	Dartmouth, Nova Scotia Canada	School for Resource and Environmental Studies Faculty of Management Dalhousie University 1312 Robie Street Halifax, Nova Scotia Canada B3H3E2
Port of Cape Charles Sustainable Technologies Industrial Park	<i>Timothy E. Hayes</i>	Executive Director	#(804)678-0477 #(804)678-0483: Fax	Northampton County Dept of Sustainable Development, Joint Industrial Dev Authority of Northampton County & Its Incorporated Towns	Port of Cape Charles, Virginia	Northampton County Dept of Sustainable Developmnt Joint Industrial Development Authority of Northampton County & Its Incorporated Towns 16404 Courthouse Road PO Box 538 Eastville, VA 23347

Table 1B. Existing Eco-Industrial Parks (Contacted)

Development Site:	Contact(s):	Title:	Telephone:	Organization:	EIP Location:	Mailing Address:
Duwamish Corridor Project	<i>Lucy Auster</i>	Economic Planner	#(206)205-0711	King County Economic Development Department	King County, Washington	King County Office of Budget & Strategic Planning King County Courthouse, Room 420 516 3rd Avenue Seattle, WA 98104
New Jersey EcoComplex	<i>Harry Janes</i>	Director	#(908)932-9711: Extension 243	Rutgers University	New Brunswick, New Jersey	New Jersey EcoComplex Rutgers University Cook College Foran Hall -- P O Box 231 New Brunswick, NJ 08903-0231
Civano, Tucson Solar Village	John Laswick Tres English	Project Manager, Solar Village Real Estate Developer	#(520)791-5093 #(520)791-5413: Fax #(602)881-8712	Office of Economic Dev	Tucson, Arizona	City of Tucson Office of Economic Development PO Box 27210 Tucson, AZ 85726-7210
Skagit County Environmental Industrial Park	<i>Kevin J. Morse</i>	Program Manager, Environmental Industries Prgm	#(360)336-6114 #(360)336-6116: Fax	Economic Development Assn of Skagit County (EDASC)	Skagit County, Washington	Economic Development Association of Skagit County 204 West Montgomery PO Box 40 Mount Vernon, WA 98273
Phoenix Industrial Park	William Snyder	Program Manager	#(541)484-5312 #(541)484-0657: Fax	Environmental Technologies	Eugene, Oregon	Environmental Technologies

Table 1C. Existing Eco-Industrial Parks (Contacted)

E-mail Address:	Web Page Address:	Contacted:	Materials Received:	Key Aspects of Development:
<p>ec23@cornell.edu weinetwork@cornell.edu dbx@ornl.gov</p>	<p>http://www.cfe.cornell.edu/wei/fairfield/feipark.html http://www.cfe.cornell.edu/WEL/wei.html</p>	<p>June 14th, 1996</p>	<p>"Fairfield Baseline Study". Also "International Symposium on Work & the Environment" -- conference proceedings (November, 1993). "Work and the Env Bibliography" -- (May, 1994). Also various pamphlets/brochures describing WEL.</p>	<p>PCSD, Fairfield dev stalled by local bureaucracy and in-fighting -- funds withheld. Rochester first EIP attempt: no further progress since initiation. Emphasis on respect for human capital in addition to environmental and industrial resources.</p>
<p>rvrvally@chattanooga.net</p>	<p>http://www.chattanooga.net/SUSTAIN/sustain_home.html http://www.chattanooga.net/zeri</p>		<p>"A Comprehensive Revitalization Strategy: The South Central Business District Plan -- Chattanooga, Tennessee" -- (January, 1995).</p>	<p>PCSD, downtown revitalization, widespread community participation. Full-scale plan inclusive of city at lg: EIP simply single element in ambitious and comprehensive entirety.</p>
<p>broedc@aol.com</p>	<p>Presently undergoing construction.</p>	<p>June 21st, 1996</p>	<p>Excerpts in "Designing, Financing and Building the Indstrl Prk of the Future" -- conference proceedings; draft of Case Study and Fieldbook (May, 1995). "Brownsville Eco-Industrial Park: The Industrial Park of the Future" -- info sheet (December, 1995). Slide presentation to Industry Advisory Board, also "What is 'industrial symbiosis?'" -- (May, 1996).</p>	<p>PCSD, subj of extensive Case Study by Research Triangle Institute (inclu economic analyses, qualitative feasibility schemes). Presently creating survey/database, eventual model to assess scenarios; future investment depends directly on results. Model with possibility of wider application.</p>
	<p>http://quasar.sba.dal.ca:2000/sres/BURN/home.html</p>	<p>June 13th, 1996</p>	<p>"The Burnside Ecosystem: An Educational Initiative for Small Business" -- compilation of <i>The Burnside Ecosystem</i> (columns included in local newsletter). "The Industrial Park as an Ecosystem Project" -- brochure describing reports/studies available.</p>	<p>Sm to med businesses in lg mall unit: exploring retrofit possibilities. Presently creating waste exchange and information database for managers. Concept requires more broad-based support than it currently enjoys -- much investment in ongoing education of existing business tenants.</p>
<p>northampton@esva.net</p>	<p>Intended eventual construction.</p>	<p>July 2nd, 1996</p>	<p>Info packet: inclu Port of Cape Charles Sustainable Technologies Industrial Park Development Mission, Project Partners, Principles for Dev, Resolution of Commitment, Sus Dev Initiative, Dev Progress to Date (June, 1996), and assorted news articles</p>	<p>PCSD, heavy community participation -- lger economic revitalization objective fused with preservation of existing resources. Less detailed involvement with EIP mix/tenant recruitment issues. Broad-based support from federal and state levels.</p>

Table 1D. Existing Eco-Industrial Parks (Contacted)

E-mail Address:	Web Page Address:	Contacted:	Materials Received:	Key Aspects of Development:
lucy.auster@metrokc.gov	http://www.pan.ci.seattle.wa.us/business/dc/	June 12th, 1996		Focus on job creation, brownfield site development; possible corridor-wide inclusion into virtual EIP. Presently conducting survey of businesses in area -- strong commitment to income generation, sustainable economic development.
	Presently undergoing construction.	June 19th, 1996	"The New Jersey EcoComplex: An Environmental Technology Research Demonstration Facility for Economic Development" -- excerpts from Iger report/grant proposal.	Critical priority is partnerships, champion in govt. Focus on recruiting advanced technology companies, less an EIP than green industrial park. Firm belief in developing/maintaining 'guarantees' for interested businesses (inclu permitting, financing options).
laswick@azstarnet.com.	http://www.enn.com/feature/fe060396/feature3.htm		"Civano Market Analysis: Consumer Attitudes Survey Results and Analysis" -- (November, 1995). "Civano Market Analysis: Tenant Attitudes Survey Results and Analysis" -- (November, 1995).	An integrated development featuring housing, retail and employment opportunities for the community. Engendered some controversy as public assistance for project necessary to spur private investment. Actual EIP an eventual addition to project.
eip@edasc.org	http://www.edasc.org/eip	June 26th, 1996	"Skagit County Environmental Industrial Park Feasibility and Planning Study" -- both full study and executive summary documents (August, 1995). Also "1995 Year in Review" -- report.	Largely rural area: prompted by severe solid waste constraints; focus on attracting recycling industries and related technology -- less an EIP than green industrial park with possibilities for marketing, distributing and retailing products locally.
bsnyder@rio.com		August 19th, 1996		

Table 2A. Existing Eco-Industrial Parks (Not Contacted)

Development Site:	Contact(s):	Title:	Telephone:	Organization:	EIP Location:	Mailing Address:
Stonyfield Farms					New Jersey	
	Jill Edwards		#(609)989-3509		Trenton, New Jersey	
	Mark Berie		#(518)561-0232	Platsburgh Airborne Redevelopment Corporation	Platsburgh, New York	
	Cindy Schmidt		#(303)497-2107	UCAR	Boulder, Colorado	
Cabazon Resource Recovery Park				Sanders International	Indio, California	

* Also mention of possible sites located in: Sarasota, Florida; Chicago, Illinois; Raymond and Richland, Washington; and Pittsburgh, Pennsylvania.

Table 2B. Existing Eco-Industrial Parks (Not Contacted)

E-mail Address:	Web Page Address:	Key Aspects of Development:
		Baseline study is being conducted by Cornell Univ.'s Work and Environment Initiative; have conducted a highly successful community roundtable.
		Project initiated by research arm of local academic institution -- emphasis on atmospheric research. Proposed site location at former Stapleton Airport.
	http://www.sandersint.com/ecos/rtp.htm	

Table 3A. Additional Contacts

Contact(s):	Title:	Telephone:	Organization:	Mailing Address(es):	Email/Web Address:	Key Aspects:
Stephen V. Dunn	Professor Summer Associate	#(215)978-5932 #(203)624-1109	Yale University Urban and Economic Dev Div US EPA	Yale University School of Forestry and Environmental Studies	sduinn@minerva.cis.yale.edu	Author of EPA base document, "About Eco-Industrial Parks: General Information and Extensive Bibliography" (August, 1995).
<i>Michelle Bell</i> (Dr. Michael Farrell)		#(423)576-2118 #(423)576-8646: Fax #(423)576-7785	Oak Ridge National Laboratory	Oak Ridge National Laboratory Bethel Valley Road PO Box 2008 Building 1505 -- MS 6038 Oak Ridge, Tennessee 37831	x65@ornl.gov http://www.ornl.gov/ http://www.esd.ornl.gov/	Similar research to educate Lab: particular focus on science and technological aspects of EIP development -- does a corresponding niche exist for national lab involvement...? Expected visit to each site -- research conclusion Fall, 1996.
<i>Gary A. Davis</i>	Professor	#(423)974-1835	Center for Clean Products and Clean Technology University of TN, Knoxville	Center for Clean Products and Clean Technology University of Tennessee , Knoxville	gadavis@utk.edu	Working presently on tenant selection criteria; "closed loop" systems possibly premature, too ambitious -- gradual development of waste exchange capabilities sounder proposal. Recycling industries useful for high value-added.
Karen Hundt Sarah McCourt	Prgm Coordinator	#(423)756-5216 #(202)408-5296	President's Council on Sustainable Development		http://www.whitehouse.gov/pcsd	Activities believed suspended as of April, 1996. No funds, other in-kind support for EIP ventures -- PCSD demonstration sites largely measure of federal endorsement for concept.
Harriet Tregoning	Director	#(202)260-2778 #(202)260-0174: Fax	Urban and Economic Dev Div US EPA	Urban and Economic Development Division US Environmental Protection Agency 401 M Street, Southwest -- Mail Code: 2125 Washington, DC 20460	tregoning.harriet@epamail.epa.gov	
Ernest Lowe		#(510)339-1090 #(510)339-9361: Fax	Indigo Development	Indigo Development 6423 Oakwood Drive Oakland, CA 94611-1350	elowe@path.net elowe@aol.com	Consultant with extensive EIP 'experience' -- helped to author Fieldbook with Research Triangle Institute on Brownsville federal demonstration grant
<i>Rosalynn Johnson</i>		#(215)978-5932	See Change	See Change Philadelphia, Pennsylvania	siera30.aol.com	Community development corporation operating in empowerment zone: focus on sustainability, new interest in green incubator. No EIP involvement as yet -- horticultural projects.
David Cobb	"Technical Genius"	#(415)768-4261	Bechtel Corporation	Bechtel Corporation		Responsible for creation of Brownsville computer simulation model to project feasible scenarios for EIP development.

Table 3B. Additional Contacts

Contact(s):	Title:	Telephone:	Organization:	Mailing Address(es):	Email/Web Address:	Key Aspects:
<i>Sheila A. Martin</i>	Senior Economist	#(919)541-5847	Research Triangle Institute	Center for Economics Research Research Triangle Institute 3040 Cornwallis Road PO Box 12194 Research Triangle Park, NC 27709-2194		Authored EIP Case Study for Brownsville, including potential industry matches and initial quantitative scenarios for development of EIP. Final authorized version of Case Study and Fieldbook pending revisions and EPA approval.
Robert Smee			National Materials Exchange Network		nmen@eznet.com	Responsible for coordination of national materials exchange network, accessible through the Internet. Covers wide variety of materials and categorized accordingly.
<i>Christine Eustis</i>		#(202)482-4290	US Department of Commerce -- Sustainable Development	National Oceanic and Atmospheric Admin. US Department of Commerce -- Room 5222 14th and Constitution Avenue, NW Washington, DC 20230		Sponsoring EIP conference with President's Council on Sustainable Development at Port of Cape Charles Sustainable Technologies Industrial Park. Compiled extensive directory of current US involvement in EIP development.