

## Context

The debate over appropriate actions to address the risks arising from changes in the Earth's climate—the “greenhouse effect”—suffers from two major information gaps. The first is a lack of consensus regarding the damages that could occur to the environment without action to reduce greenhouse gas (GHG) emissions. The scientific process may not precisely predict the nature and implications of climate changes that would occur if society does not make significant changes in energy and land use patterns associated with higher levels of GHG emissions. That is, the costs of inaction and the benefits of taking mitigation actions are uncertain.

The second information gap is lack of understanding of the monetary costs associated with undertaking mitigation to reduce greenhouse gasses. The absence of hard, proven data on greenhouse gas mitigation costs reduces the quality of the climate policy debate.

The nature of the implied cost-benefit analysis underlying the climate debate suggests that for any particular level of benefits accruing from action to mitigate climate change, a high cost of mitigation will lead policy makers to take less action. If mitigation costs are proven to be low, it appears policy makers would support stronger action to address climate change. At this time, however, we lack the data for realizing the costs involved in pursuing climate mitigation actions.

To help fill this gap, Environmental Financial Products, in collaboration with the Kellogg Graduate School of Management at Northwestern University, received a Millennium grant of \$374,000 from the Chicago-based Joyce Foundation in May 2000. With \$900 million in assets, the Foundation has been a longtime and well-respected funder of efforts to protect the natural environment of the Great Lakes region. The grant, part of a series supporting work on significant intergenerational issues, enabled us to explore the feasibility of designing a voluntary market to help answer the second question: the cost of steps to reduce climate change.

The ultimate objective of the proposed Chicago Climate Exchange is to generate price information that provides a valid indication of the cost of mitigating greenhouse gases. By closing the information gap on mitigation costs, society and policymakers will be far better prepared to identify and implement optimal policies for managing the risks associated with climate change.

## Overview and Methodology

This report presents a feasibility analysis and initial architecture for a voluntary pilot greenhouse gas emissions trading program that would be launched in the Midwest and expanded over time. The objectives of the pilot program—hereafter called the Chicago Climate Exchange (CCX)—are:

### Proof of concept:

- demonstrate the ability to cut and trade greenhouse gases in a market system involving multiple industrial sectors, mitigation options and countries;
- initiate greenhouse gas reductions through a modest size but scalable program;
- form a basis of experience and learning for participants;
- introduce a phased, efficient process for achieving additional GHG reductions in the future.

**Price discovery:**

- provide realistic information signaling the cost of mitigating greenhouse gases;
- enhance the quality of climate policy decision-making by providing hard data on mitigation costs to the public and policymakers.

The strategy used to assess the feasibility of a pilot GHG market relied on several research methodologies. A theoretical economic assessment accompanied by quantified data guided the structure of the study. The proposed market architecture was influenced by lessons from other successful emissions, financial, and commodity markets. The successful USEPA SO<sub>2</sub> emissions trading program to reduce acid rain served as a model for the design of key elements of the Chicago Climate Exchange.

The research is a continuing work in progress. The next step of the process is to incorporate industry input to refine the initial proposed market terms and conditions. This process will yield a working prototype for which an attempt to build a consensus will be initiated. That consensus design would represent a functional architecture for the first phase of a market. Implementing the proposed market design and incorporating lessons from practical experience are core elements of the program.

**Market Architecture and Participants: Theory and Design**

The negative effects caused by the release of greenhouse gases are currently not priced. Consumers and businesses do not fully take account of such effects in their economic decision-making because there is no price on the use of the atmosphere. The goal of the proposed pilot greenhouse gas trading program is to establish the market for discovering the price for reducing emissions. The core steps are to limit overall consumption of the atmosphere (GHG emissions) and establish trading in instruments that allow participants to find the most cost-effective methods for staying within a target emission limit. The market price of those instruments will represent a value signal that should stimulate new and creative emission reduction strategies and technologies. Emissions trading is a proven tool that works with and harnesses the inventive capabilities of business.

Various market architecture design options were considered. A market could include emission limits taken by fossil fuel producers and processors—the “upstream” entities in the carbon emissions cycle—or by major “downstream” sources that burn fossil fuels, such as electric power generators, factories, and transport firms. An “intermediary” level approach could focus on firms that produce energy consuming devices, such as automobiles, or other intermediaries such as fuel distributors. Based on responsiveness (the ability of participants to directly cut emissions), administrative costs and existence of successful precedents, the recommended approach is a predominantly “downstream” approach. Accordingly, the research findings suggest the CCX should aim to include participation by large emission sources at the downstream level (e.g. power plants, refineries, factories, vehicle fleets).

In order to incorporate other mitigation projects that add to the flexibility of the market (and which are gaining international recognition as valid projects), the proposed design would also allow crediting for a range of offset projects that encourage micro-level GHG mitigation actions. Reflecting international consensus and successful precedent, the items to be traded in the pilot market—GHG emission allowances and offsets—are instruments representing one ton of carbon dioxide (CO<sub>2</sub>) or their equivalent (CO<sub>2</sub>e). For every ton of CO<sub>2</sub> emitted, a participating emission source must relinquish one allowance or offset.

## Potential For A Market Initiated in the U.S. Midwest

The Midwest represents a microcosm of the U.S. The region's economy is as large as the economies of the United Kingdom (U.K.) and the Netherlands combined and has annual GHG emissions equal to those of the U.K. plus France (1.375 billion tons CO<sub>2</sub>). The region's industrial diversity—including a broad range of energy, heavy manufacturing, transport, agriculture, pharmaceuticals, electronics and forestry—make it well-suited as a starting point for a robust and representative greenhouse gas emissions trading market.

The feasibility analysis suggested a hypothetical target market covering 20% of all Midwest emissions. The scale of such a market and the proposed GHG mitigation goals are summarized in Table A. The Table portrays a proposed GHG reduction schedule calling for emissions in the first year of a pilot market, 2002, to be 2% below 1999 levels (the baseline year) and falling a further 1% each year from 2003 through 2005.

**Table A Scale of a Hypothetical Midwest GHG Market and Mitigation During 2002-2005 (in million metric tons CO<sub>2</sub> equivalent)**

Estimated Midwest 1999 emissions	1,375
1999 emissions of a hypothetical 20% coverage market	275
Cumulative <i>baseline</i> emissions during 2002-2005 under for the 20% coverage scenario	1,100
Cumulative 2002-2005 CCX emissions <i>target</i> for hypothetical 20% coverage program (2% below 1999 levels during 2002, 3% below 1999 in 2003, 4% below in 2004, 5% below in 2005)	1,061.5
<b>Four-year Mitigation Demand (baseline emissions – target)</b>	<b>38.5 mil. tons CO<sub>2</sub>e</b>

The hypothetical 20% coverage Midwest market appears to provide sufficient scale for a pilot market that could be representative of a larger market. Total emissions covered in such a market would equal the emissions of Scandinavia (Denmark, Finland, Norway and Sweden) and would be more than double the emissions covered in the successful internal GHG market operated by BP-Amoco. While broad coverage is an ultimate goal, the main benefits of a pilot—proof of concept and price discovery—can be realized with a modest size but a diverse set of participants.

## Proposed Market Architecture and Mechanics

Table B summarizes the core elements of the proposed market architecture.

**Table B**  
**Indicative Term Sheet**  
**Market Architecture for the Chicago Climate Exchange**

<b>Geographic Coverage</b>	2002: emission sources and projects in seven Midwest states (IA, IL, IN, MI, MN, OH, WI), offsets accepted from projects in Brazil;  2003-2005: emission sources and projects in U.S., Canada and Mexico, offsets accepted from projects in Brazil.
<b>Greenhouse Gases Covered</b>	Carbon dioxide, methane and all other targeted GHGs
<b>Emission Reduction Targets</b>	2002: 2% below 1999 levels, falling 1% per year through 2005
<b>Industries and Firms Targeted</b>	Primarily “downstream” participants: power plants, refineries, factories, vehicle fleets; approximately 100 firms initially targeted; individual entities or operating groups must produce over 250,000 tons CO <sub>2</sub> e to become a participating emission source
<b>Tradable Instruments</b>	Fully interchangeable emission allowances (original issue) and offsets produced by targeted mitigation projects
<b>Eligible Offset Projects</b>	<ul style="list-style-type: none"> <li>- Carbon sequestration in forests and domestic soils</li> <li>- Renewable energy systems activated after 1998</li> <li>- Methane destruction in agriculture, landfills and coalbeds</li> <li>- Offset projects must be over 100,000 tons CO<sub>2</sub>e; smaller offset projects must aggregate reductions to meet the requirement</li> </ul>
<b>Annual Public Auctions</b>	2% of issued allowances withheld and auctioned in “spot” and “forward” auctions, proceeds returned <i>pro rata</i>
<b>Central Registry</b>	Central database to record and transfer allowances and offsets; interfaces with emissions database and trading platform
<b>Trading Mechanisms</b>	Standardized CCX Electronic Market, private contracting
<b>Trade Documentation</b>	Uniform documentation provided to facilitate trade
<b>Accounting and Tax Issues</b>	Accounting guidance suggested by generally accepted accounting principles; precedent exists for U.S. tax treatment
<b>Market Governance</b>	Self-governing structure to oversee rules, monitoring and trade

The following summarizes the mechanics of the proposed system:

1. Participating emission sources agree to the prescribed emission limits and standardized emissions monitoring and reporting rules.
2. Participating emission sources receive a four-year stream of emission allowances equal to their target emission level.
3. Emission offsets may be generated by independently verified GHG mitigation projects.

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4. Starting in 2002, annual allowances and offset holdings must cover annual emissions.
  5. Participants can comply by cutting their own emissions or purchasing emission allowances from those who make extra emission cuts or from offset projects.
  6. Failure to fulfill commitments triggers automatic non-compliance penalties.
  7. Periodic auctions and organized trading will reveal market prices.

Tradable emission allowances and offsets exist and are transferred as records in a publicly accessible computerized tracking system called the Registry. Each unit is assigned a unique identification number. A variety of best-practice methods for measuring or calculating GHG emissions will be applied, including continuous emissions monitoring, fuel records and mass balance calculations. Methods for addressing new entrants and facilities and partial ownership of emission sources have been proposed but need further refinement based on industry input.

Emission offsets reflect mitigation actions generated by individual projects undertaken by entities not qualified to be emission sources (generate less than 250,000 tons CO<sub>2</sub>e emissions reductions per year). When possible, standard rules and conservative reference emission values can be used to determine offset project effectiveness. Offsets are earned by undertaking specified mitigation projects that must be independently verified. Multiple small offset projects will be grouped into 100,000 ton pools. Offset projects must follow standardized registration, reporting and verification processes. This design feature is intended to produce fungible instruments that will be recognized in other emerging carbon markets.

Examples of eligible offset projects include:

- Carbon sequestration from forest expansion, and domestic no-till agricultural soils and agricultural tree and grass plantings;
- Electric power generated by wind, solar and geothermal systems;
- Methane capture and destruction (e.g. from agricultural waste, landfills and coal mines).

Selected categories of offsets can be implemented in Brazil. This feature allows the pilot market participants to develop expertise on issues associated with cross-border transactions, including the opportunity to develop trading across differing legal and regulatory systems. Brazil also represents a natural location as it has extensive linkages to many Midwest businesses, presents a variety of low-cost mitigation opportunities, and its policymakers are actively preparing for the international carbon market.

Annual auctions of emission allowances will be held to help stimulate the market and publicly reveal prices. To complement private contracting, an electronic mechanism for hosting CCX trading will provide a central location that facilitates trading and publicly reveals price information. Several existing trading systems will be considered for use in the CCX market. Trading will be encouraged by provision of uniform trade documentation and by listing standardized spot and forward contracts on the CCX electronic market.

## **Market Administration Issues, Public Policy Context**

Administration of the CCX market by an efficient, corporate style governance system, with an elected Board of Directors and a strong Chief Executive, is recommended. The rules structure and decisions of the governing body should be codified through a Rulebook. Under the guidance of the Board and the Rulebook, a professional staff should be responsible for making most operational decisions and managing outside vendors. In order to assure the market incorporates current best practices, several expert advisory committees will be convened, including committees on rules and enforcement; market operations and technical specifications; and emissions and project monitoring, verification and audits.

The capabilities of various service providers who might construct and/or operate an emissions and emissions trading registry were examined. Discussions have been held with Environmental Resources Trust, Epotec, PricewaterhouseCoopers and the Emissions Trading Group in the U.K. Each group offers potentially attractive features that will be further examined. EFP has also worked to build links to other emerging GHG markets (e.g. the UK), multilateral organizations, national governments, corporations, non-governmental organizations and financial and commodity exchanges.

Professional research on the accounting and tax issues associated with participating in the CCX was conducted under subcontract by PricewaterhouseCoopers LLP. An extensive body of guidance on both accounting and tax issues associated with emissions trading has been established in the U.S. Preliminary indicative guidance is provided on proper accounting and income tax treatment for issues associated with enrollment in the market, trading, swaps, auctions and participation costs.

A variety of legislative proposals have provided further indication that participation in CCX will help position participants to intelligently influence and benefit from possible future regulations. Legislative proposals to require reductions in power plant CO<sub>2</sub> emissions, and to assist or reward farm and forest carbon sequestration, could introduce a policy environment that provides competitive advantages to CCX participants.

## **Industry Outreach, Response**

In order to identify potential CCX participants, a database containing salient information on major Midwest emission sources was assembled and screened based on various criteria. Many Midwest businesses have already initiated climate change programs, and some industries, including the electric power industry, are already involved in emissions trading. Approximately 100 companies met the screening criteria. Additional screening identified forty firms that received first-round invitations to participate in forming the market. Sectors represented in this list include: electric power, auto manufacturers, petroleum refining, transport, pharmaceuticals, forest and paper, chemical manufacturers, and computers and telecommunications.

The broad outreach program also involved development of a CCX website and brochures, thirty conference presentations in eight countries, ten pieces of print media coverage, four electronic media events, and three EFP-authored publications featuring CCX.

Thirty-four entities recognized as leaders in their industries provided a positive response to the invitations to participate in CCX. Each entity signed a letter indicating their intent to help form the CCX rules and, if the rules are consistent with their objectives, to participate in the CCX market. Included are major manufacturers such as DuPont and Ford Motor Company, leading diversified energy companies such as Cinergy and Calpine, major international financial entities such as Swiss Re, agricultural businesses such as Growmark and Agrilience, and Zahren Alternative Power, a leading landfill gas energy company. Appendix A provides a brief description of the entities from which a positive response has been received to date.

### **High-Level CCX Advisory Board**

A high-level Advisory Board has been formed to receive strategic input from top world experts from the environmental, business, academic and policy-making communities. Members of the Board include internationally recognized environmental leaders such as Maurice Strong and Israel Klabin, former governors of U.S. states (James Thompson and David Boren), and individuals who have served in senior positions in major businesses and academic institutions, such as Donald Jacobs and Jeffrey Garten. The dignitaries serving on this Board can help inform corporate and governmental decision-makers and contribute to the formation of a robust group of CCX market participants. Appendix B provides a brief biographical summary of each of the individuals who have agreed to serve on the CCX Advisory Board.

### **Next Steps**

The report constitutes an initialization of a market architecture. It is the first step of an iterative process to be used in defining and implementing a pilot market. The next step is to build consensus on the initial architecture by further incorporating industry input through a Technical Committee comprised of experts, including representatives of the entities identified in Appendix A. The subsequent step will be preparation and launch of the first phase of the pilot market. Further iteration will involve refinement of market operations based on actual experience with the market, and expansion to allow increased participation and broader geographic coverage.

Detailed discussions with participants and service providers will be undertaken in order to identify a consensus on the market architecture and implementation plan. This effort will aim to finalize emission baselines, targets, timetables, as well as rules on emissions monitoring, non-compliance penalties, new entrants, and jointly owned facilities. Proposed rules must be finalized for emission offset standards, mechanics of aggregating offsets and project verification. A simultaneous effort can be undertaken to select vendors for the registry and trading platform, and to enroll project verifiers. The consensus market design will be codified in the CCX Rulebook, which will also establish the responsibilities and operating procedures of the CCX governance structure.

Pre-launch preparation of the market will entail official enrollment of participating emission sources, activation of the Registry, and placing emission allowances in the accounts of participants. Launch of the market will require initiation of the emission monitoring and reporting procedures, accepting applications from offset projects, and activation of the electronic trading mechanism.

Operation of the market during the first year will include execution of the first auction, acceptance of quarterly emission monitoring reports, issuance first-year offsets based on independent verification reports, and the compliance “true-up” subsequent to year end. A process for expanding the market will be established in order to allow for orderly growth of participation.

## Appendix A

### Entities participating in the design phase of the Chicago Climate Exchange<sup>sm</sup>

**Agrilience:** Agrilience is a partnership of agricultural producer-owners, local cooperatives and regional cooperatives. Agrilience offers crop nutrients, crop protection products, seeds, information management, and crop technical services to producers and ranchers in all 50 states as well as Canada and Mexico. It has sales and marketing offices in St. Paul, Minn., and Kansas City, Mo. Agrilience, LLC was formed on February 3, 2000, as an agronomy marketing joint venture between Cenex Harvest States Cooperatives, Farmland Industries, Inc. and Land O'Lakes, Inc.

**Alliant Energy:** Alliant Energy Corporation is a growing energy-service provider with both domestic and international operations. Headquartered in Madison, Wis., Alliant Energy provides electric, natural gas, water and steam services to more than two million customers worldwide. Alliant Energy Resources Inc., the home of the company's non-regulated businesses, has operations and investments throughout the United States, as well as Australia, Brazil, China, Mexico and New Zealand.

**BP p.l.c.** is the holding company of one of the world's largest petroleum and petrochemicals groups. BP's main activities are exploration and production of crude oil and natural gas; refining, marketing, supply and transportation; and manufacturing and marketing of petrochemicals. BP has a growing activity in gas and power and in solar power generation. BP has well-established operations in Europe, North and South America, Australasia and Africa.

**Calpine:** Headquartered in San Jose, CA, Calpine has an energy portfolio comprised of 50 energy centers, with net ownership capacity of 5,900 megawatts. Located in key power markets throughout the United States, these centers produce enough energy to meet the electrical needs of close to six million households. Calpine was ranked 25<sup>th</sup> among FORTUNE magazine's 100 fastest growing companies and it was recently ranked by Business Week as the 3<sup>rd</sup> best performing stock in the S&P 500.

**Carr Futures/Crédit Agricole Indosuez:** Carr Futures, a subsidiary of Crédit Agricole Indosuez, is a global institutional brokerage firm headquartered in Chicago. Carr holds memberships on all major futures and equity markets worldwide, and consistently ranks among the largest futures brokerage firms in the world.

**Cinergy Corp.:** Based in Cincinnati, Ohio, Cinergy Corp. is one of the leading diversified energy companies in the U.S. Its largest operating companies, The Cincinnati Gas & Electric Company (Ohio), Union Light, Heat & Power (Kentucky), Lawrenceburg Gas (Indiana), and PSI Energy, Inc. (Indiana), serve more than 1.5 million electric customers and 500,000 gas customers located in a 25,000-square-mile service territory encompassing portions of Indiana, Ohio and Kentucky. The interconnections of Cinergy's Midwestern transmission assets give it access to 37 percent of the total U.S. energy consumption.

**DTE Energy** is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. DTE Energy's principal operating subsidiaries are Detroit Edison, an electric utility serving 2.1 million customers in Southeastern Michigan, and Michigan Consolidated Gas, serving 1.2 million customers in Michigan.

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**DuPont:** DuPont is a science company, delivering science-based solutions that make a difference in people's lives in food and nutrition, health care, apparel, home and construction, electronics, and transportation. Founded in 1802, the company operates in 70 countries and has 93,000 employees.

**Exelon Corporation** is one of the nation's largest electric utilities with approximately five million customers and more than \$15 billion in annual revenues. The company has one of the industry's largest portfolios of electricity generation capacity, with a nationwide reach and strong positions in the Midwest and Mid-Atlantic. Exelon distributes electricity to approximately five million customers in Illinois and Pennsylvania and gas to 425,000 customers in the Philadelphia area. The company also has holdings in such competitive businesses as energy, infrastructure services and energy services. Exelon is headquartered in Chicago.

**Ford Motor Company:** is the world's second largest automotive company. Its Automotive operations include: Ford, Mercury and TH!NK brands; wholly owned subsidiaries Volvo, Jaguar, Aston Martin and Land Rover; Mazda (33 percent ownership); and Quality Care and Kwik-Fit. Ford Financial Services, providing automotive financing and other services, and The Hertz Corporation, providing car rental services, are the other major components of Ford Motor Company. Ford's vision is to become the world's leading consumer company for automotive products and services. Ford Motor Company cares about preserving the environment for future generations, and is dedicated to providing ingenious environmental solutions that will position them as a leader in the automotive industry of the 21<sup>st</sup> century and contribute to a sustainable planet.

**GROWMARK, Inc.:** GROWMARK, headquartered in Bloomington, Illinois, is a federated regional cooperative that provides agriculture-related products and services primarily in Illinois, Iowa, Wisconsin and Ontario, Canada. FS-brand farm supplies and related services are marketed to farmers in these areas by nearly 100 GROWMARK member cooperatives. Visit the GROWMARK Web site at [www.fssystem.com](http://www.fssystem.com).

**IGF Insurance Company:** IGF Insurance Company is the fifth-largest crop insurance company. IGF serves farmers in 46 states and maintains eight service offices nationwide. IGF prides itself in developing niche products for farmers' risk management needs.

**Interface, Inc.** Interface is a global company, producing in 33 manufacturing sites located in the United States, Canada, the United Kingdom, the Netherlands, N. Ireland, Australia, and Thailand. Interface produces commercial broadloom carpet, textiles, chemicals, architectural products, access flooring systems, and manufactures and sells more than 40 percent of all the carpet tile used in commercial buildings today.

**International Paper:** With over 12 million acres of land managed in the United States alone, International Paper is one of the world's largest private landowners. International IP has significant global businesses in paper and paper distribution, packaging and forest products, including building materials.

**Iowa Farm Bureau Federation:** The Iowa Farm Bureau is a Federation of 100 county Farm Bureaus in Iowa. The organization was founded in 1918 and is currently comprised of more than 154,000 member families throughout the state. Numerous legislative, educational and service-to-member programs are provided for the members' benefit. The Iowa Farm Bureau's mission is to help farm families prosper and improve their quality of life. It is an independent, non-governmental, voluntary organization. It is local, statewide, national and international in its scope and influence and is nonpartisan, nonsectarian and nonsecret in character.

**IT Group, Inc.** is a provider of diversified, value-added services in the areas of consulting, engineering and construction, remediation and facilities management. Through the Company's diverse group of highly specialized companies, clients can take advantage of a single, fully integrated delivery system and expertise to meet their global environmental needs. Its broad range of services includes the identification of contaminants in soil, air and water and the subsequent design and execution of remedial solutions.

**Manitoba Hydro** is a major energy utility headquartered in Winnipeg, Manitoba serving 403,000 electric customers throughout Manitoba and 248 000 gas customers in various communities throughout southern Manitoba. Virtually all electricity generated by the provincial Crown Corporation is from renewable water power. We are the major distributor of natural gas in the province. The Corporation's capital assets-in-service at original cost exceed \$8 billion, making it the fourth largest energy utility in Canada.

**Mead Corporation** a forest products company with \$4.4 billion in annual sales, is one of the leading North American producers of coated paper, coated paperboard and consumer and office products, a world leader in multiple packaging and specialty paper, and a producer of high-quality corrugating medium. In management of the company's more than two million acres of forests, Mead is committed to practicing principled forest stewardship and using resources in a responsible and sustainable manner. Headquartered in Dayton, Ohio, Mead has more than 15,100 employees and offices and operations in 32 countries.

**Midwest Generation:** Headquartered in Chicago, Midwest Generation, a subsidiary of Edison Mission Energy, owns 13 electricity generating units in Illinois and Pennsylvania. With a total generating capacity of over 11,400 megawatts, Midwest Generation can generate enough electricity to meet the needs of more than 13 million homes. Midwest Generation is exclusively in business to sell wholesale power in competitive electricity markets. The company is currently undertaking a major program to reduce emissions from its coal-fired plants.

**National Council of Farmer Cooperatives:** NCFC's mission is to protect the public policy environment in which farmer-owned cooperative businesses operate, promote their economic well-being, and provide leadership in cooperative education. NCFC remains the only organization serving exclusively as the national representative and advocate for America's farmer-owned cooperative businesses.

**NiSource Inc.,** is a holding company with headquarters in Merrillville, Ind., whose operating companies engage in all phases of the natural gas and electric business from exploration and production to transmission, storage and distribution of natural gas, as well as electric generation, transmission and distribution. Its operation companies provide service to 3.6 million customers located within the high-demand energy corridor that stretches from the Gulf of Mexico through the Midwest to New England.

**Nuon** is one of the largest multi-utility companies in the Netherlands, serving more than 2.5 million residential and business customers with electricity and, in many instances, with gas, water and heat as well. The company is in the forefront in the marketing of green energy and renewable energy generation in the Netherlands and is extending its knowledge and experience in the area of renewable energy internationally. Nuon's activities in the field of renewable energy include wind power, small hydropower, thermal and photovoltaic solar energy, landfill gas, biogas, biomass and ambient heat.

**ORMAT:** ORMAT is the world leader in distributed reliable remote microturbine power units (also known as Closed Cycle Vapor Turbo Generators). ORMAT's operations use locally available heat sources, including geothermal energy (steam and hot water), industrial waste heat, solar energy, biomass, and low grade fuels.

**Pinnacle West Capital Corp:** Based in Phoenix, Ariz., Pinnacle West is the parent company of APS and Pinnacle West Energy. APS is Arizona's largest and longest-serving electric utility, serving more than 857,000 customers, and Pinnacle West Energy is the company's unregulated wholesale generating subsidiary. Among the utilities listed in the S&P 500, Pinnacle West is ranked in the top 10 percent for environmental performance by an international investment advisory firm. The Company also is ranked in the top 10 percent by Fortune magazine for total shareholder return over the last five years.

**PG&E National Energy Group,** headquartered in Bethesda, Md., develops, owns and operates electric generating and gas pipeline facilities and provides energy trading, marketing and risk-management services in North America. The National Energy Group operates power production facilities with a capacity of about 7,000 megawatts, with another 10,000 megawatts under development, and more than 1,300 miles of natural gas transmission pipeline with a capacity of 2.7 billion cubic feet per day. (PG&E National Energy Group is not the same company as Pacific Gas and Electric Company, the California utility, and is not regulated by the California Public Utilities Commission. Customers of Pacific Gas and Electric Company do not have to buy products or services from PG&E National Energy Group in order to continue to receive quality regulated services from Pacific Gas and Electric Company.)

**STMicroelectronics:** STMicroelectronics is the world's third largest independent semiconductor company whose shares are traded on the New York Stock Exchange, on Euronext Paris and on the Milan Stock Exchange. The Company designs, develops, manufactures and markets a broad range of semiconductor integrated circuits (ICs) and discrete devices used in a wide variety of microelectronic applications, including telecommunications systems, computer systems, consumer products, automotive products and industrial automation and control systems. In 2000, the Company's net revenues were \$7.8 billion and net earnings were \$1.45 billion.

**Suncor Energy, Inc.** is a Canadian integrated energy company that explores for, acquires, produces, and markets crude oil and natural gas, refines crude oil, and markets petroleum and petrochemical products. Suncor has three principal business units: Oil Sands, Exploration and Production, and Sunoco. Oil Sands produces light sweet and light sour crude oil, diesel fuel and various custom blends from oil sands and markets these products in Canada and the United States. Exploration and Production explores for, acquires, develops, produces and markets crude oil in Canada and natural gas throughout North America. Sunoco refines and markets crude oil and a broad range of petroleum and petrochemical products in Ontario and the United States.

**Swiss Re:** Founded in 1863 in Zurich, Switzerland, Swiss Re is the world's second largest reinsurer, with roughly 9,000 employees and gross premiums in 2000 of CHF 26 billion (USD\$15.3 billion). Standard & Poor's gives the company its AAA rating; Moody's rates it Aaa. Swiss Re does business from over 70 offices in 30 countries. The world over, Swiss Re offers insurers and corporates: classic (re)insurance covers, alternative risk transfer (ART) instruments, and a broad range of supplementary services for comprehensive risk management.

**Temple-Inland Inc.** is a diversified forestry, forest products and financial services company. Its three main operating divisions include a Paper Group, which manufactures corrugated packaging products; a Building Products Group, which manufactures a wide range of building products and manages the Company's forest resources consisting of approximately 2.2 million acres of timberland in Texas, Louisiana, Georgia and Alabama; and the Financial Services Group, which consists of savings bank, mortgage banking, real estate, and insurance brokerage activities.

**The Nature Conservancy:** The Nature Conservancy, a nonprofit organization founded in 1951, is the world's largest private international conservation group. TNC has protected over 12,089,000 acres of land in the United States.

**Waste Management, Inc.** as a leading provider of comprehensive waste management services, Waste Management serves municipal, commercial, industrial and residential customers throughout North America. Headquartered in Houston, Texas, the Company's network of operations includes 284 active landfill disposal sites, 16 waste-to-energy plants, 73 landfill gas-to-energy facilities, 160 recycling plants, 293 transfer stations and more than 1,400 collection facilities. Combined, these resources allow Waste Management to offer a full range of environmental services to approximately 25 million residential and two million commercial customers nationwide.

**Wisconsin Energy Corporation**, headquartered in Milwaukee, Wis., is an \$8.4 billion holding company with a diversified portfolio of subsidiaries engaged in electric generation; electric, gas, steam and water distribution; pump manufacturing and other non-utility businesses. The corporation's utilities subsidiaries serve more than one million electric and 950,000 natural gas customers in Wisconsin and Michigan's Upper Peninsula.

**ZAPCO:** Zahren Alternative Power Corporation (ZAPCO), recently acquired by U.S. Energy, is among the largest and most respected developers of Landfill Gas (LFG) projects in the United States. ZAPCO is engaged in the development, financing, and operation of a large and diverse group of LFG-based projects, including waste-to-energy electricity systems, and has executed international trades of greenhouse gas reductions involving over two million tons CO<sub>2</sub> equivalent. ZAPCO operates ten of its twenty-seven LFG projects in the Midwest U.S.

## Appendix B

### Biographies of the Advisory Board

**David L. Boren** is the President of the University of Oklahoma. Mr. Boren has had a distinguished career in public service as a member of the Oklahoma House of Representatives (1967-1975), Governor of Oklahoma (1975-1977) and as a U.S. Senator (1979-1994). As a U.S. Senator, Mr. Boren was the longest-serving Chairman of the Senate's Select Committee on Intelligence. Mr. Boren was educated at Yale and attended Oxford University as a Rhodes Scholar. He also earned a law degree from the University of Oklahoma College of Law.

**Lucien Y. Bronicki** is the Chairman of Ormat International, an Israeli company leader in the field of innovative technology solutions to geothermal power plants, power-generation from industrial waste heat and solar energy projects. Mr. Bronicki has been Chairman of Ormat since he founded the company in 1965. Mr. Bronicki holds various professional affiliations and memberships, including Chairman World Energy Council's Israeli National Committee, Member of the Executive Committee of the Weizmann Institute of Science and member of the Board of Ben Gurion University. He is also the recipient of several business and science related awards.

**Ernst Brugger** is Founding Partner and Chairman of Brugger Hanser & Partner Ltd. in Switzerland, a business consulting firm with international experience and range. He is also a professor at the University of Zurich, chairman and member of the board of various companies and a member of the International Committee of the Red Cross (ICRC). Dr. Brugger serves as Chairman of the Board of Directors of Sustainable Performance Group, an investment and risk management company which invests in pioneering and leading companies which have taken up the cause of sustainable business

**Jeffrey E. Garten** is dean of the Yale School of Management. Formerly undersecretary of commerce for international trade in the first Clinton Administration, he also held senior economic posts in the Ford and Carter administrations. From 1979 - 1992, he was a managing director first at Lehman Brothers, where he oversaw the firm's Asian investment banking activities from Tokyo, and then at the Blackstone Group. Currently a monthly columnist for Business Week, his latest book is "The Mind of the CEO" (2001)."

**Donald P. Jacobs** is Dean of the Kellogg Graduate School of Management and its Gaylord Freeman Distinguished Professor of Banking. Under his leadership, the Kellogg School has become a leader in the field of business and finance and is consistently ranked as one of the top five business schools in the United States. Dean Jacobs is a former Chairman of the Board of Amtrak (1975-1979) and currently serves on several corporate boards. His work on banking, corporate governance and international finance has been published in many scholarly journals and he holds several honorary degrees and professional awards.

**Dennis Jennings** is the Global Risk Management Solutions Leader for PricewaterhouseCoopers' (PwC) Global Energy and Mining Industry Practice. Mr. Jennings previously served as the Dallas/Fort Worth Energy Industry Market Leader; Co-Chairman of the U.S. Oil and Gas Industry Program; and on Steering Committee of the International Energy Practice. Mr. Jennings is experienced in all sectors of the petroleum industry (upstream, downstream, domestic and international) and the service industry. His responsibility have included leading PwC's global risk management practice for the energy and mining industry,

providing financial advice and performing due diligence reviews on numerous merger, acquisitions and divestiture efforts by major international corporations.

**Joseph P. Kennedy II** is Chairman and President of Boston-based Citizens Energy Group. Before returning to Citizens Energy, Mr. Kennedy represented the 8th Congressional District of Massachusetts in the U.S. House of Representatives for 12 years. Mr. Kennedy founded the non-profit company in 1979 to provide low-cost heating oil to the poor and elderly. Under his leadership, Citizens grew to encompass seven separate companies, including the largest energy conservation firm in the U.S. Mr. Kennedy also advises and serves on the boards of several companies in the energy, telecommunications, and health care industries. Mr. Kennedy is the son of the late U.S. Sen. Robert F. Kennedy.

**Israel Klabin** is the president of the Brazilian Foundation for Sustainable Development, a major Brazilian non-governmental organization devoted to issues of environmental and sustainable development policy. Mr. Klabin is the former chairman of Klabin SA, one of the largest forestry companies in Latin America. He is a former mayor of Rio de Janeiro and was one of the main Brazilian organizers of the United Nations Conference on the Environment (Rio 92). He is also actively involved in several philanthropical activities.

**Bill Kurtis** has had a distinguished career in broadcasting for over 30 years, as a news anchor in Chicago and later of the national *CBS Morning News*. He started his own company, Kurtis Productions, when he returned to Chicago in the mid 1980's and currently hosts shows on the Arts and Entertainment network. Mr. Kurtis is involved in The National Science Explorers Program, Electronic Field Trips and the Electronic Long Distance Learning Network, all aimed at teaching children about science. Mr. Kurtis and his shows have been the recipients of several awards. He serves on the board of directors of organizations devoted to natural history and the environment, including the National Park Foundation, the Nature Conservancy and the Kansas State Historical Society.

**Jonathan Lash** is President of the World Resources Institute (WRI), a Washington, DC-based non-governmental organization that provides solutions to global environment and development problems. From 1993 until 1999, Mr. Lash served as co-chair of the President's Council on Sustainable Development, a group of government, business, labor, civil rights, and environmental leaders that developed recommendations for national strategies to promote sustainable development. For two years before joining WRI, Mr. Lash directed the environmental law and policy program of the Vermont Law School. From 1987 to 1991, Mr. Lash headed the Vermont Agency of Natural Resources, having served the previous two years as Vermont's Commissioner of Environmental Conservation. He is the author of several books on environmental topics.

**Thomas E. Lovejoy**, is a world-renowned tropical and conservation biologist. Dr. Lovejoy is generally credited with having brought the tropical forest problem to the fore as a public issue, and is one of the main protagonists in the science and conservation of biological diversity. In 1987, he was appointed Assistant Secretary for Environmental and External Affairs for the Smithsonian Institution and is Counselor to the Smithsonian's Secretary for Biodiversity and Environmental Affairs. Dr. Lovejoy is also Chief Biodiversity Advisor to the President of the World Bank and the Bank's Lead Specialist for the Environment in Latin America. From 1989 to 1992, he served on the President's Council of Advisors in Science and Technology (PCAST), and acted as scientific adviser to the Executive Director of the United Nations Environment Programme (1994-97). He was the World Wildlife Fund's Executive Vice President from 1985 to 1987. Dr. Lovejoy is the author of numerous articles and books.

**David Moran** is vice president of ventures for the Electronic Publishing group of Dow Jones & Company and president of Dow Jones Indexes. Mr. Moran became president of Dow Jones Indexes on a full-time basis in June 1998. He was elected to a one-year term as chairman of STOXX, Ltd., an index creator that is a joint venture of the German, Paris and Swiss stock exchanges and Dow Jones, in April 1999. He is also chairman of Dow Jones Sustainability Group Index GmbH. Prior to joining Dow Jones, Mr. Moran was an associate with Patterson, Belknap, Webb & Tyler, a New York City law firm, from 1979 to 1985.

**Les Rosenthal** is a former Chairman of the Chicago Board of Trade (CBOT) and a principal of Rosenthal Collins, a leading Chicago-based commodities and futures trading firm. During his time as member of the Board and Chairman of the CBOT, Mr. Rosenthal was instrumental in advancing the cause of new and innovative exchange-traded products such as Treasury Bond futures and insurance derivatives.

**Mary L. Schapiro** is President of NASD Regulation, Inc. (NASDR) and a member of the Board of NASD, Inc. NASDR was created as an independent National Association Securities Dealers, Inc. (NASD) subsidiary responsible for regulating 5,500 member brokerage firms, 670,000 individual registered representatives and oversight of The Nasdaq Stock Market. Ms. Schapiro was formally the Chairman of the Commodity Futures Trading Commission. Ms. Schapiro also served as a Commissioner of the Securities and Exchange Commission (SEC). Ms. Schapiro was an active member of the Technical Committee and the Developing Markets Committee of the International Organization of Securities Commissions (IOSCO) and has worked extensively with developing markets on capital markets regulatory structure. In May 2000, Ms. Schapiro was named the Financial Women's Association Public Sector Woman of the Year.

**Maurice Strong** is a former Secretary General of the 1992 United Nations Conference on Environment and Development (the Rio Earth Summit) and Under-Secretary General of the United Nations. He is currently the Chairman of the Earth Council, a non-governmental organization dedicated to the cause of sustainable development. In June of 1995, he was named Senior Advisor to the President of the World Bank. From December 1992 until December 1995, Mr. Strong was Chairman and Chief Executive Officer of Ontario Hydro, one of North America's largest utilities. Mr. Strong is an advisor to the United Nations, and has been a director and/or officer of a number of Canadian, U.S. and international corporations.

**James R. Thompson** is a former four-term Governor of Illinois and currently a managing partner of Winston and Strawn. During his last term as Governor, Mr. Thompson was involved in the implementation of the sulfur dioxide (SO<sub>2</sub>) market created by the 1990 Clean Air Act. During his last term as Governor he was the Head of the Global Climate Change Task Force at the National Governors' Association (1988-1989). Governor Thompson is also a director of the Chicago Board of Trade (CBOT).

**Sir Brian Williamson** is the Chairman of the London International Financial Futures and Options Exchange (LIFFE), one of the world's largest exchanges. Mr. Williamson has been involved in trading financial futures for almost three decades in London, New York and Chicago. He held senior executive positions for prominent trading firms and was a member of the International Advisory Board of the Nasdaq Stock Market, becoming Chairman in 1996. He was also Governor-at-Large of the National Association of Securities Dealers in Washington DC. (1995-1998).