PN. ACS-682

Technical Training and Municipal/NGO/University Networking for Energy Efficiency

Final Report
Energy Efficiency and Environmental Management Workshop

Prepared by:

The University of Tennessee
Schools of Business and Engineering
Central and East European Center
Alliance of Universities for Democracy

Under Subcontract to:

Electrotek Concepts, Inc.
Arlington, Virginia USA

Prepared for:

United States Agency for International Development
Warsaw, Poland and Washington, DC
Regional Energy Efficiency Project (180-0030)
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and

Participating Universities:
Academy of Mining and Metallurgy
Warsaw Technical University
Silesian Technical University
Technical University of Kraków

22 January 1999

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February 13-18, 1998

Introduction

Table I: Proposed Schedule

Introduction of instructors

Training course objectives

TABLE 1
Proposed Framework for Training
Energy Efficiency and Env. Management
Krakow, Poland/February 13-18, 1998

	DAY 1 Friday Feb. 13	DAY 2 Saturday Feb. 14	DAY 3 Sunday Feb. 15	DAY 4 Monday Feb. 16	DAY 5 Tuesday Feb. 17	DAY 6 Wednesday Feb. 18
MODULE I 8:45-10:15 AM		• Overview of topics for energy eff. curriculum dev. (J) • Matching learning obj. and pedadogy (F)	• Electric Power and manufacturing plants. • Intro to energy law (J)	• Opportunities for practice oriented training. The Assessment Center model. (J)	• Intro to TQEM & ISO 14000 (F)	• Packaging of training, program development & industrial relations (J)
MODULE II 10:30 AM-12:00 PM		• The "Commons Game" -- (an experiential exercise demonstrating Hardin's thesis (F)	• Case studies energy efficiency/ environmental management ... The "Green Lights" case (D)	• Stakeholder relationships in EEM.."the Carlesbad Highlands Case" (F)	• ISO 14000 (cont.) -- The International Electric Hardware Case (D)	• Concluding discussions (ALL) • Course evaluation
		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
MODULE III 1:15 - 3:15 PM		• Env. Economic and Regulation (D)	• "The Power House" -- a computer-based model of energy efficiency (D&f)	• Group decision making exercise "Jungle Survival" (F)	• Pollution prevention -- "The Fun Factory" (D&F)	
		• Recap of learning	• Recap of learning	• Recap of learning	• Recap of learning	
MODULE IV 3:30 - 4:45 PM		• Introduction to internet resources (K)	• Residencial energy use and software tools (K)	• Energy & Env. resources on the internet (K)	• Energy & Env. resources on the internet (K)	
	DINNER					
MODULE V 7:00-8:00 PM	• Introductions • Role of universities in energy effic. • Training obj. (J)					

Training Course on Energy Efficiency/Curriculum
Krakow, Poland/February 13-18, 1998

Instructors

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RICHARD JOHN JENDRUCKO

Current Position

Professor, Department of Mechanical and Aerospace Engineering and Engineering Science, University of Tennessee, Knoxville; Director, Industrial Assessment Center, University of Tennessee, Knoxville

Professional Interests

Industrial Waste Minimization, Industrial and Building Energy Conservation and Systems Engineering

Education

Ph.D., Biomedical Engineering, University of Virginia-1972; M.Ch.E., Chemical Engineering, University of Virginia- 1968; B.Ch.E.Chemical Engineering, Manhattan College, New York-1966

Recent Special Training

U.S. Department of Energy Electric Motor System Performance Optimization Service Technical Training Course, University of Wisconsin, Madison, WI, February 7-9, 1995

Environmental Regulation Training Course, The University of Tennessee Center for Industrial Services, Waste Reduction Assistance Program, Knoxville, TN, October 18, 1994.

Pollution Prevention Opportunity Assessment Performance-Based Training Course, Allied Signal Aerospace, Kansas City, Missouri, August 31-September 1, 1994.

Professional License and Certification

Registered Professional Engineer, Texas; No. 37133
Tennessee Energy Authority, Energy Auditor Certification; No. 79-KN-A11
Association of Energy Engineers, Certified Energy Manager; No. 1488

Highlights of Professional Experience

Professor, Department of Mechanical and Aerospace Engineering and Engineering Science, University of Tennessee, 1985-present.

Director, U.S. Department of Energy-sponsored University of Tennessee Industrial Assessment Center (formerly Energy Analysis and Diagnostic Center), September 1983-present. Staff Engineering Auditor, 1979-1983; Conducted over 300 energy and waste audits of small-and-medium sized industrial manufacturers.

Director, U.S. Environmental Protection Agency-sponsored University of Tennessee Waste Minimization Assessment Center, July 1988-1993.

Selected Recent Honors and Awards

American Society for Engineering Education Certificate of Recognition for exceptional contributions to the Society, The Energy Conversion and Conservation Division, and the profession of Engineering, 1993.

Commendation in recognition of 8 years of service in industrial energy conservation as Director of the University of Tennessee Energy Analysis and Diagnostic Center, U.S. Department of Energy, June 28, 1991.

Society Memberships

Association of Energy Engineers, Senior Member, 1986-present
American Society for Engineering Education:
- Chairman, Energy Conversion and Conservation Division, 1990-1991
- Vice Chairman, Energy Conversion and Conservation Division, 1989-1990
- Secretary-Treasurer, Energy Conversion and Conservation Division, 1988-1989
- Program Chairman, Energy Conversion and Conservation Division, 1987-1988

International Experience

Project Co-principal Investigator and Lecturer, US Agency for International Development, Technical Training and Municipal, Non-governmental Organization and University Networking for Energy Efficiency in Poland, November 1997-June 1998.

Project Co-principal Investigator and Lecturer, US Agency for International Development, Technical Training and Municipal, Non-governmental Organization and University Networking for Energy Efficiency in the Czech Republic, November 1996-May 1997.

Member of DOE-sponsored fact-finding-team visiting Warsaw, Krakow and Katowise, Poland, November 24-December 7, 1990. The team generated specific proposals for DOE support of energy conservation programs in Poland.

Lecturer, Seminar on Energy Conservation and Management, sponsored by the Energy Committee of the Republic of China Ministry of Economic Affairs, Taipei, Taiwan, December 15-19, 1980.

Participant, Republic of China-USA Joint Workshop on Industrial Energy Conservation, Taipei, Taiwan, May 5-9, 1980.

Selected Recent Publications

Jendrucko, R. J., L. M. Buchanan, and J. G. Overly, "Factors Affecting the Implementation of Waste Production Measures in Small-To-Medium-Sized Manufacturing Plants," presented at the 1997 Environmental Technology Expo., Atlanta, November 21, 1997 and published in the Proceedings, Chapter 61, pp. 469-474.

Jendrucko, R. J., "The Use of An Intensive, Structured Technique for the Performance of Resource-Limited Pollution Prevention Assessment of Industrial Manufacturers," accepted for presentation at the EPA Region 4 Pollution Prevention/Green Manufacturing Conference for Industry and Business, Atlanta, November 18, 1997.

Counce, R. M., R. J. Jendrucko, et al., "Incorporating Pollution Prevention and Sustainable Development in Engineering Education," presented at the Eighth Annual Conference of the Alliance of Universities for Democracy, Warsaw, Poland, November 4, 1997.

Thomas, T., R. J. Jendrucko, and J. Peretz, "The Distribution of Industrial Waste Generation and Energy Use Characteristics in Available Federal and State Databases," Chapter 3 in Competitive Energy Management and Environmental Strategies, Association of Energy Engineers Books, Atlanta, Georgia, 1995.

Jendrucko, R. J. and J. G. Overly, "Comparison of Energy and Waste Management Costs and Associated Measures for Cost Reduction in Small and Medium-Sized Manufacturing Plants," presented at the 18th World Energy Engineering Congress, Atlanta, November, 1995.

Jendrucko, R. J., T. N. Coleman, and T. M. Thomas, "Waste Reduction Manual for Lithographic and Screen Printers," published by the Tennessee Valley Authority for the University of Tennessee Center for Industrial Services, August 1995 (78 pages).

Additional Recent Professional Activities

Lecturer, Waste Reduction for Manufacturing Extension Partnerships, Ogden, Utah, December 8-10, 1997.

Lecturer, Tennessee Industrial Workshops on Surface Coatings: Issues and New Technologies, Knoxville, April 22; Nashville, April 23; and, Memphis, April 24, 1997.

Administration and Lecturer, Industrial Energy Conservation and Waste Reduction Workshops, Memphis, Tennessee, June 18, 1996; Hazard, Kentucky, March 20, 1996; Nashville, Tennessee, February 28, 1996; and Knoxville, Tennessee, November 29, 1996.

Lecturer, Industrial Workshops on Waste Reduction for Lithographic and Screen Printers in Tennessee: Knoxville, July 13, 1995, Chattanooga, July 12, 1995, Nashville, July 11, 1995 and Memphis, July 10, 1996.

Lecturer, U. S. Department of Energy, Energy Analysis and Diagnostic Center, Waste Reduction Training Courses, Knoxville, Tennessee, December 6-7, 1993, Washington, D.C., August 9-12, 1994, Baltimore, MD, August 11-13, 1995.

GERALD E. FRYXELL

PERSONAL INFORMATION

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Languages: Familiarity w/ Romanian, Spanish & Swahili

EDUCATION

Ph.D. -- Management (Business Strategy & Policy) 1986
Indiana University--Bloomington, Indiana

M.B.A. 1979
Seidman Graduate School of Business Administration
Grand Valley State Colleges--Allendale, Michigan

M.T. (ASCP) -- Medical Technology 1971
Quad-City Hospital's School of Medical Technology--
Davenport, Iowa

EXPERIENCE

University of Tennessee--Knoxville 1986-Present
- Associate, Central and Eastern European Studies
- Core Faculty in Tennessee Institute for Management of Environment
- Executive training under Management Education and Entrepreneurship Training program (CSFR & Poland, 1991)
- Consultant and Trainer in USIA grant for curriculum development at Technical University in Timisoara, Romania 1995-6)
- Consultant in USAID project in Czech Republic and Poland to improve energy efficiency and environmental management (1996-7)
- Co-developer of "Friends & Partners--Romania" web site: http://www.friends-partners.org/fpromania

Academie Studii de Economice (ASE)-- Bucharest, Romania 1993-4
- Curriculum reform & management training

Eastern and Southern African Management Institute--Tanzania 1989-90
- Executive programs in Tanzania & Kenya
- Training needs assessment

Mercy Hospital--Muskegon, Michigan 1972-79
- Clinical Bacteriology, Virology & Chemistry

PUBLICATIONS

Twenty referred articles: Academy of Management Journal; Business & Society; Journal of Management; Organization Studies; Journal of Business Ethics.
Plus numerous book chapters, reviews and other publications.
Topics addressed: Environmental management; international joint ventures; management of innovation.

EXTERNAL GRANTS

United States Information Agency, "Enabling efficient and autonomous action in local governments of four Transylvanian Judets." [$150,000]--Dec, 1995 to Nov., 1996.
Funding for strengthening local governments in four Romanian cities and to help mitigate dependency on central administration in Bucharest.

United States Information Agency, "Civic networking in Alba and Maramures" [$86,000]--pending
Funding for the promotion of grass roots involvement in internet at the community level and through linking civic networks to those in US and using these linkaged for distance education.

National Science Foundation, "Justice norms and productivity in the biotechnology firms" [$25,000]--June, 1992 to May, 1993.
Funding for qualitative research in 8 biotechnology firms in the S.E. and California in order to understand how successful firms reconcile the need to reward scientists as indivuduals while at the same time creating a climate of teamwork.

PRESENTATIONS

30 presentations at national meetings of academics and practioners in the United States, Europe, and Africa.

Thomas J. Dean

Associate Professor of Management
The University of Tennessee at Knoxville

EDUCATION

University of Colorado	Ph.D. in Strategic Management: 5/92
Oklahoma State University	M.B.A.: May, 1987
The Pennsylvania State University	B.S. in Environmental Management: 12/82

INDUSTRY AND TEACHING EXPERIENCE

University of Tennessee	Associate Professor of Management;9/91 to present
	Fellow of UT's Energy, Environment, and Resources Ctr
University of Oregon	Lundquist Visiting Professor of Entrepreneurship; 1/97-6/9
University of Colorado	Research and Teaching Assistant; 9/87 to 8/91
Illinois Institute of Technology Research Institute	Chemist/Data Analyst; 8/83 to 5/87
Department of Energy	Research Intern: 5/83 to 8/83
Pennsylvania Power & Light Co.	Environmental Cost Analyst/Programmer; 5/82 to 8/82

Miscellaneous Consulting Clients
Eugene Water and Electric Board, Thomas & Betts Corporation, Lockheed Martin Energy Systems, St Mary's Hospital, Hauser Chemical Research Corporation, Advanced Composite Technology Incorporated, Engineering Measurements Company.

PROFESSIONAL HONORS AND ACTIVITIES

Chair, Research Committee, Academy of Management Entrepreneurship Division, 1997-1998.
Member, Research Committee, Academy of Management Entrepreneurship Division, 1996-1997.
Secretary, Academy of Management Entrepreneurship Division, 1995-1996.
Winner of the Academy of Management Entrepreneurship Division's Dissertation Award for Outstanding Research in Entrepreneurship-Independent Business.
Winner of the 1992 best article award in, *Entrepreneurship Theory and Practice.*
Winner of the "1992 Competition for the Best Paper on Entrepreneurship and Innovation" from New York University's Center for Entrepreneurial Studies.
Finalist for the University of Tennessee, College of Business Allen H. Keally teaching award.
Advisory Board, Collegiate Entrepreneurs Association
Ad Hoc Reviewer, Journal of Business Venturing
Ad Hoc Reviewer, Academy of Management Journal

GRANTS AND CONTRACTS

USIA Civic Networking Project in Romania, 1996.
U.S. Small Business Administration Research Contract. "Pollution Regulation and New Venture Formations in U.S. Manufacturing Industries: A Longitudinal Analysis of Deterrent Effects."
U.S. Small Business Administration Research Contract..
New York University Center for Entrepreneurial Studies Research Grant.

SELECTED PUBLICATIONS

Dean, T. J., Brown, R. L., & Bamford, C.E. Forthcoming. The Differential Impact of Industry Structural Characteristics on the Formation of Small and Large Establishments: Implications for Small Business Business Theory and Entry Strategy. Strategic Management Journal.

Dean, T. J. & Fryxell, J. 1997. International Hardware Products, Inc.: Implementing an ISO 14001 Environmental Management System Published by the Management Institute for Environment and Business of the World Resources Institute.

Dean, T. J., Fryxell, G. E., Vryza, M. Forthcoming. Do corporate political strategies restrict competition? An examination of corporate PACs as a barrier to entry. Business and Society.

Brown, R. L., Dean, T. J., & Douglas, T. J. 1997. Environmental Regulation and Competitive Advantage: New Insights into Entry Effects and Industry Structural Characteristics. Research in Corporate Social Performance and Policy, 15.

Dean, T. J. & Meyer, G. D. 1996. Industry Environments and New Venture Formations in U.S. Manufacturing: A Conceptual and Empirical Analysis of Demand Determinants. Journal of Business Venturing 11 (2):107-132.

Judge, W., Dean, T. J., & Fowler, D. 1996. Organizational Responses to Strategic Issues Posed by the Natural Environment: An Application of Miles and Snow's Strategic Types. Industrial and Environmental Crisis Quarterly, 9 (4): 419-447.

Dean, T. J. 1995. New Venture Formations in U.S. Manufacturing: The Role of Industry Environments. NY, Garland Publishing.

Dean, T. J. & Brown, R. L. 1995. Pollution Regulation as a Barrier to New Firm Entry: Initial Evidence and Implications for Future Research. Academy of Management Journal, 38 (1): 288-303.

Dean, T. J., Meyer, G. D., & DeCastro, J. 1992. Determinants of New-Firm Formations in Manufacturing Industries: Industry Dynamics, Entry Barriers, and Organizational Inertia. Entrepreneurship Theory and Practice, 17 (2). Winner of *Entrepreneurship Theory and Practice 1992 Best Article Award.*

Training Course Objectives

1. To clarify the important roles of universities in promoting energy efficiency and environmental management.

2. To establish the important linkages between energy efficiency enhancement and enviromental management.

3. To review the historical evolution of U.S. energy and environmental law having broad impact on industrial operations.

4. To present the evolution and current status of the development of international standards for environmental management.

5. To present computer and Internet-based training applications for energy efficiency enhancement.

6. To present and promote a variety of non-traditional methods for the training of engineering students in decision-making for energy efficiency improvement and environmental management including:

    - In-classroom activities

        - Analysis of case studies

        - Simulation exercises

        - Cooperative projects with industry

        - Short courses for industry professionals skills updating

    - Supplementary educational activities

        - industrial internships

        - government-sponsored outreach activities

Roles of Universities in Promoting Energy Efficiency and Environmental Management

1. Education of Enrolled Students

   - Training in the methods of improvement of efficiency in the operation of combustion, mechanical and electrical systems

     Topical Subject Examples:
     - Efficient combustion burner design
     - Automatic systems for air/fuel ratio control
     - Minimization of electric motor energy losses
     - Design of variable speed drive systems
     - Minimization of electrical distribution system losses

   - Development of a general knowledge base and awareness of:

     - The relative availability of natural resources (fuels and manufacturing materials).

     - The increases in energy cost related to availability and user demand.

     - The achievement of energy conservation by:

       Utilizing state-of-the-art equipment.

       Optimal equipment operation and maintenance for achieving peak efficiencies.

     - The detrimental environmental effects of energy use in society.

     - The need for and development of international and local laws to protect environmental quality.

2. Provision of Guidance to Governmental Bodies:

   - Research results to guide energy and environmental management policy development.

3. Education of the Public:

- Awareness of the finite availability and costs of dwindling energy resources.
- The degrading effects of energy use on the environment
- Their direct role in:
    - Minimizing personal energy use (e.g. home insulation, use of public transportation).

February 14, 1998

Module 1

Overview of Topics

Learning objectives and pedagogy

Overview of Topics for Energy Efficiency Curriculum Development

I. Industry Needs
- Energy availability and quality
- Low cost energy supply
- Efficient process use of energy
- Energy use minimizing environmental impacts
- Management systems for energy efficiency and environmental impacts

II. Relevant Academic Subjects

A. Technical:
- Energy sources:
  - Non-renewable: coal, oil, gas, nuclear
  - Renewable: biomass, solar, wind, hydro power, geothermal
  - Waste: wood, refuse, solvents
- Primary energy conversion:
  - Power/thermal plants → air emissions → local and international environmental controls
  - Nuclear fuel production
  - Fossil fuel refineries
- Energy transmission/transportation
  - Coal: rail, truck, water
  - Oil: pipeline, rail, truck, water
  - Natural gas: pipeline
  - Nuclear: rail, truck, water
  - Electricity distribution systems
- End use:
  1. Industrial
     - Electricity
       - motor drives
       - process heating
       - facility lighting
     - Fossil Fuels
       - process and building heating

- Equipment energy conversion efficiency
  - combustion systems
  - mechanical drives
  - lighting systems

- Waste production
  - solid waste: hazardous and non-hazardous
  - air emissions
  - wastewater

2. Commercial: space conditioning, lighting, hot water
   - Equipment efficiency

3. Residential: space conditioning, hot water, appliances
   - Equipment efficiency

4. Transportation: rail, automotive, air
   - Equipment efficiency
   - Air emissions

B. Non-Technical
- Government regulation:
  - Energy: availability (distribution), pricing, equipment efficiency

  - Environmental impacts: air emissions (power plants, automobiles), industrial plants hazardous waste, wastewater, air emissions

- Financing of energy/environmental projects

- Management:
  - Energy purchase and use; energy service companies
  - Environmental impacts (international standards: ISO 14000)

- Social issues

III. Packaging of Topical Material for University Training Programs

A. Engineering and Management Degree Programs
- Curricula:
  1. Required courses (e.g., electric power, thermodynamics, combustion systems)

  2. Elective courses (e.g., industrial pollution prevention, environmental management, (MBA))

- Programs supplementing classroom instruction (e.g., industrial internship programs)

B. Short Courses for Practicing Professionals
- Design
- Costing
- Marketing
- Staffing
- Scheduling

IV. Delivery/Teaching Methods

A. On-Campus:
- Classroom lecture
- Laboratory experiences
- Research projects
- Discussion of case studies
- Experiential exercises
- Industrial projects

B. Off-Campus
- Industrial internships
  1. Cooperative education programs
  2. Internship programs

- Special industrial programs
  1. Industrial Assessment Center Program

C. Financial Support for Non-Traditional Educational Programs

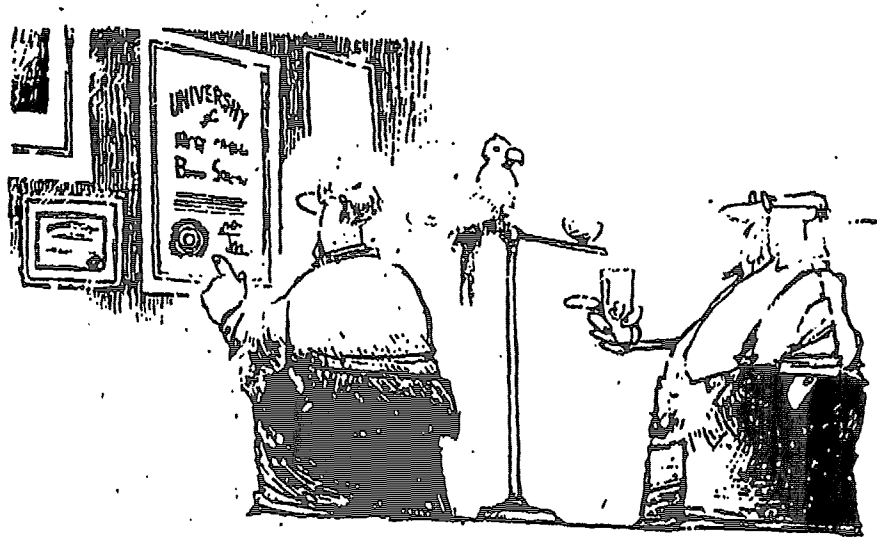
V. Information/Resources

A. Internet
- Databases
- Vendor information
- Training materials

B. Governmental Agency Publications
- US Department of Energy (DOE)
- US Environmental Protection Agency (EPA)

C. Other Sources

NON SEQUITUR ..... By Wiley



HE EARNED IT FAIR AND SQUARE. AND AS LONG AS HE'S ABLE TO REPEAT WHAT HE HEARS, HE CAN EARN A DEGREE FROM ANY COLLEGE IN THE COUNTRY

WILEY

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CIVIC EDUCATION PROJECT REPORT

Chronicle of Higher Education, 5/9/97

"Lecture-style teaching that discourages student participation and independent thought is still too common..."

"...students tended to be, and often still are, passive learners. They listen to their professors lecture, they take notes, they regurgitate answers on exams."

For free copy write:
Civic Education Project
Nador Utca 9
Budapest 1051
Hungary

QUESTIONS ASSOCIATED WITH ENERGY EFFICIENCY PROGRAM

- What is involved in attaining energy efficiency (as part of a much larger issue concerning sustainable development)?
- How does one learn about energy efficiency and environmental management?
- What are the implications for an engineering curriculum?

THE ELEMENTS OF ENERGY EFFICIENCY

- TECHNICAL SOLUTIONS
  (e.g., computer controlled motors)
  - Basic & applied research
  - Entreprenuership & Intrapren.
  - Resource Availability
- DEREGULATION
  (e.g., relaxation of subsidies)
  - Privatization
  - Market interventions (sep. meters)
- REGULATION
  - Legislation (CAFE)
  - Administrative Law (permitting)
- INSTITUTION BUILDING
  - Identification of common goals (preempting legislation)
  - Building collaboration & trust (ISO)
- CHANGE PREMISES/ASSUMP.
  - Long-term cost/benefits ("G-lights")
  - Responsibilities (finite fossil fuels)
  - Raise awareness of impacts (CO_2)
  - Behavioral change (car pools)

MATCHING PEDAGOGIES TO THESE ELEMENTS

ELEMENT OF EE	LEARNING OBJ.
• TECHNICAL SOLUTIONS - Basic & applied research - Entreprenuership - Resource Availability	MEMORIZE FACTS DEVELOP CONCEPTS
• DEREGULATION - Privatization - Market interventions	UNDERSTAND TECHNIQUES ACQUIRE SKILL -- TASK SKILLS
• REGULATION - Legislation - Administrative Law	-- INTERPERSONAL SKILLS -- RATIONAL
• INSTITUTION BUILDING - Identification of goals - Building collaboration	CHANGE ATTITUDES
• CHANGE PREMISES/ ASSUMP. - Long-term cost/benefits - Responsibilities - Raise awareness of impacts - Behavioral change	CLARIFY VALUES CHANGE BEHAVIOR DEVELOP 'WISDOM"

MATCHING PEDAGOGIES TO THESE ELEMENTS (cont.)

LEARNING OBJ.	PEDAGOGIES
MEMORIZE FACTS DEVELOP CONCEPTS	LECTURE
UNDERSTAND TECHNIQUES ACQUIRE SKILL -- TASK SKILLS -- INTERPERSONAL SKILLS -- RATIONAL	VIDEOS LECTURE W/ DISCUSSION PROBLEM SETS
CHANGE ATTITUDES	ROLE PLAY
CLARIFY VALUES	FIELD PROJECTS
CHANGE BEHAVIOR	CASE STUDIES
DEVELOP 'WISDOM"	SIMULATIONS OJT SENSITIVITY TRAINING

IMPLIED RESPONSE

GLOBAL CHALLENGES
- Market convergence
- Imp. global infrastructure
- Lowering trade barriers
- Greater access to factor markets
- Global telecommunications
- Currency exchange
- Overlapping tech.

REQUIRED ENG. RESPONSE
- > Alliances & IJVs
- > Cross-functional coordination
- > Stakeholder mgmt.
- > Competitive adv.
  - Quality
  - Cost (energy eff.)
  - Speed
- > Cross specialization
- > Flatter orgs.

GLOBAL REALITIES
- Environmental Issues
- Business legitimacy questioned
- Resource constraints
- Human diversity
- International Stds.
- Global competition driven by powerful economic consortia
- Interdependence

- > Relevance (technology & application)
- > Content breadth
  - -- Dual specializations(?)
  - -- Interpersonal skills
  - -- International standards (ISO series)
  - -- Commons Problem
- > Pedagogical variety (more experiential)
- > International programs & projects

February 14, 1998

Module II

Commons Simulation

Players Manual
Forms
Overheads

COMMONS SIMULATION

SATURDAY--MODULE III

LIST OF MATERIALS:
1) PLAYER'S MANUAL
2) PROFIT/LOSS TALLY SHEET

PARTICIPANTS STOP AFTER READING 1&2

3) COPIES OF OVERHEADS

PLAYERS MANUAL
COMMONS SIMULATION

RULES:

(1) YOU MAY TALK FREELY TO THE OTHER MANAGERS IN YOUR PLANT, BUT DO NOT TALK TO MANAGERS FROM OTHER PLANTS UNLESS GIVEN EXPLICIT PERMISSION!!!

(2) STAY ON THE SAME TRIAL AS EVERYONE ELSE!

(3) FILL IN ALL THE INFORMATION ON YOUR TALLY SHEET.

OBJECTIVE:

You (and your team members) comprise the top management team of a sizable manufacturing facility in Kivulini-- a country which is expected to experience rapid industrialization because of its low-wage structure and loose regulations. You and your team are somewhat troubled because you know that the financial performance of your plant has been discussed at headquarters and they have quite bluntly informed you that they expect higher returns on their invested capital. You are uncertain about whether the plant will be closed if your plant's profitability doesn't improve, but you are quite sure that your own compensation and career track in the company are related to the financial performance of the plant. Currently, your team has 100 pazoozas--the currency of Kivulini--in uncommitted funds.

Your plant, along with a number of other plants, is located on a large inland freshwater lake, Lacul Gunoi, upon which there are two cities (Porto Deano and Mji ya Ian) with a combined population of about 200,000 people. Importantly, all the plants (and the cities) desire a continuous, unpolluted source of water for their manufacturing processes (and quality of life as all of you live nearby the lake). Currently, while water quality has deteriorated noticeably in the last few years, the water is still acceptable. The lake has a restricted outlet and does replenish itself, but within limits.

Unfortunately, while each plant needs a good source of water, each releases a number of toxic pollutants into the lake. Currently, neither the national nor local governments regulate either the amount of water taken from the lake or the amount of waste released into it. Consequently, the condition of the lake is determined mainly by the plants themselves.

PROBLEM:

In sum, the problem facing you as a plant management team is, "How do we profitably operate our plant when our process is dependent on the lake as a public resource?"

PROCEDURE.

You will be confronted with a series of decision opportunities (trials) in which you must choose a course of action regarding your use of the lake water. Your management team may choose among five options prior to each trial (among three options initially):

(1) RED--you continue to use the lake water as you've always used it--releasing the toxic byproducts into the lake.

(2) BLACK--recognizing the deterioration of water quality, you limit pollution into the lake (e.g., by storing it, treating it, cutting back on production, or subcontracting its removal). Should the opportunity present itself to discuss this problem with other plant managers, choosing black implies compliance with any agreements or understandings to reduce levels of lake pollution.

(3) YELLOW --you take unilateral, technical measures to make your process less dependent on lake water and, as a result, less dependent on the actions of the other plants.

(4) BLUE (Available only after round 7)--you expend financial resources to enable a third party or agency to institute fines for polluters in the next trial (i.e., those choosing red).

(5) ORANGE (Available only after round 7)--you use financial resources to enable an association to reward the most cooperative team in the next trial (i.e., the team which has chosen black most often).

Note that only black, red and yellow choices are available during the first 7 trials.

Each choice has financial outcomes:

RED and BLACK: Financial outcomes associated with black and red choices depend on how many plants used those approaches. For example, if all plants on the lake limit their pollution (i.e., by choosing black), every plant will benefit by having cleaner water. However, if a single plant reduces pollution while all other continue to pollute (i.e., by choosing red), that single plant would incur the costs of reducing pollution with little benefit. Conversely, if all plants but one reduce their pollution by choosing black, the one rogue plant which continues to pollute by choosing red will accrue benefits from being a "free rider."

In addition to being dependent on the pattern of choices, payoffs are also dependent on the quality of the river. Of course, as the water quality deteriorates, all plants production processes will suffer. Conversely, as water quality improves, all benefit.

Red choices will cause degradation of water quality. The facilitator will announce how many peg movements downward will attend each red choice (usually one or two, depending on the size and composition of the group). Black choices, on the other hand, neither degrade nor improve water quality. Water quality is only improved by natural processes; the lake water is flushed out by the annual, and often heavy, Spring rains.

The status of the lake will be shown by the location of a marker on a board, strip or blackboard. The marker will move up or down as the status of the lake changes. Every five trials, the peg will be moved up as a consequence of the natural restoration of the lake.

These two influences (i.e., the number of plants polluting and water quality) are incorporated into different payoff matrices). The facilitator will display the correct payoff matrix corresponding the condition of the lake prior to each decision period (the simulation begins with the payoff matrix "0" (which represents water that is just "adequate" for your production processes. The payoff matrix will be changed as water quality either improves or deteriorates). For example, assume that water quality has deteriorated somewhat over a number of trials so that water quality is "-2." In this event, the "-2" matrix would be displayed for the next decision and would then be used to calculate the payoffs for those plants selecting either the red (pollute) or black (cooperate) options.

YELLOW: The yellow alternative (reduced dependence) costs a fixed amount of 20 pazoozas in the trial it is chosen. However, this choice adds 2 pazoozas onto whatever you earn or lose for the remainder of the simulation. This return takes effect three trials after the investment. The reasoning is that R&D used to develop a process which is less dependent on lake water will cost the company initially in the developmental phase, but have a future payoff after an implementation phase. Yellow may only be chosen once, however, after three implementation trials, the 2 pazooza payoff from choosing Yellow continues throughout the game. (While there is some inconsistency in playing red after choosing yellow, for simplicity--at least during the first few attempts at conducting this simulation--this bonus is best granted regardless of the option selected.)

BLUE & ORANGE: The blue alternative (fines) and orange (reward) alternative each cost 3 pazoozas (i.e., the resources expended by your plant to initiate a third party, agency, or association which enforces the fines and to gives rewards) in each trial it is chosen. The effect of the blue choice (i.e., the fine) is that it takes away all pazoozas that red choosing firms would have had if the fine had not been imposed and imposes a 5 pazooza fine. However, just as in the real world not all polluters

are caught In this case polluters are caught about 25% of the time (actually a very high rate of enforcement effectiveness). Consequently, enforcement will be determined by double coin toss by the facilitator; with two consecutive heads required to catch the polluting factory. Those who are caught will have their identity made public by the facilitator (those not detected keep their anonymity). To keep things simple, in the event that two or more teams choose blue, we maintain the 25% catch rate arguing that the extra resources are used up in "administrative overhead "

The orange choice rewards the cleanest plant by adding 5 pazoozas onto the pazoozas already earned by the plant that has chosen black the most often at that point in the simulation. In addition, they will receive the "Green Award" which they can proudly display until the next time it is awarded. The facilitator will announce the winner of the award. Ties between two or more teams will be resolved by a coin toss, lottery, or by placing the resources in a pool for future use (in the event there are no "stand outs" as determined by the facilitator).

The effect of these choices is summarized below:

"Commons" Game

Costs & Earnings Schedule

Color	Earnings/Costs for Team	Consequences for Other Plants	Lasting Effects
Red	See Payoff Matrix	—	—
Black	See Payoff Matrix	—	—
Yellow	-20 Pz	—	+2 to Team starting 3 trials after investment
Blue	-3 Pz	"Red" Plants -5 Pz fine & loss of payoff*	—
Orange	-3 Pz	Most Exemplary Plant +2	—

*If caught (determined by double coin toss).

SPECIAL TRIALS

At round 5 an appeal to conscience is recommended. Such an appeal will consist of the government of Kivulini stating that they have become aware of a pollution problem on Lacul Gunoi and asking all plants on the lake to please reduce their pollution levels. It is important to point out that such an appeal implies no consequences or enforcement whatsoever.

Before round 8, a conference will be permitted among the plant representatives. [NOTE: The form of these conferences may vary based on the preferences of the facilitator. It is also possible to double the payoffs, if desired, to place additional pressure on the groups to devise a solution. The facilitator will announce if any options are in effect.] Other conferencing trials are indicated on the instructor's log sheet.

INDICATING YOUR CHOICE

Your management team will indicate your choice when the facilitator or assistant comes by your plant (a color chip is stapled in your simulation folder--you may choose to point to the color of your choice). The simulation will continue until it is terminated by the facilitator.

RECORD KEEPING

Each plant's management team will be given a profit/loss statement for recording the payoff obtained for each trial and for keeping track of their cumulative gain (or loss). A copy of this profit/loss sheet is provided in Exhibit 2. At the beginning of the simulation, the cumulative score is set at 100 which reflects the amount of pazoozas you have available.

Exhibit 2

PARTICIPANT'S P/L ACCOUNT

TRIAL	CHOICE	SCORE	ADJ.	TOTAL FOR TRIAL	CUMULATIVE SCORE
ONLY BLACK, RED, OR YELLOW CHOICES IN FIRST 7 ROUNDS*					100pz
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
ALL CHOICES AVAILABLE					
8	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____
11	_____	_____	_____	_____	_____
12	_____	_____	_____	_____	_____
13	_____	_____	_____	_____	_____
14	_____	_____	_____	_____	_____
15	_____	_____	_____	_____	_____
16	_____	_____	_____	_____	_____
17	_____	_____	_____	_____	_____
18	_____	_____	_____	_____	_____
19	_____	_____	_____	_____	_____
20	_____	_____	_____	_____	_____

Note: Cumulative score can go negative up to -50 pazoozas. Plants with cumulative balances less than -50 will be closed down pending a review of their financial viability.

* Once the yellow option is used, it cannot be selected again, +2 points should can be added to all following trails under "adjustments."

PLEASE!

DO NOT TURN
THIS PAGE UNTIL
AFTER
COMPLETING THE
SIMULATION

"Commons" Game

Posting Results

PLANT #	CUMULATIVE SCORE (pz)	#BLACK	#RED	#ORANGE	#BLUE	#YELLOW

THE TRAGEDY OF THE COMMONS
(Hardin, 1968)

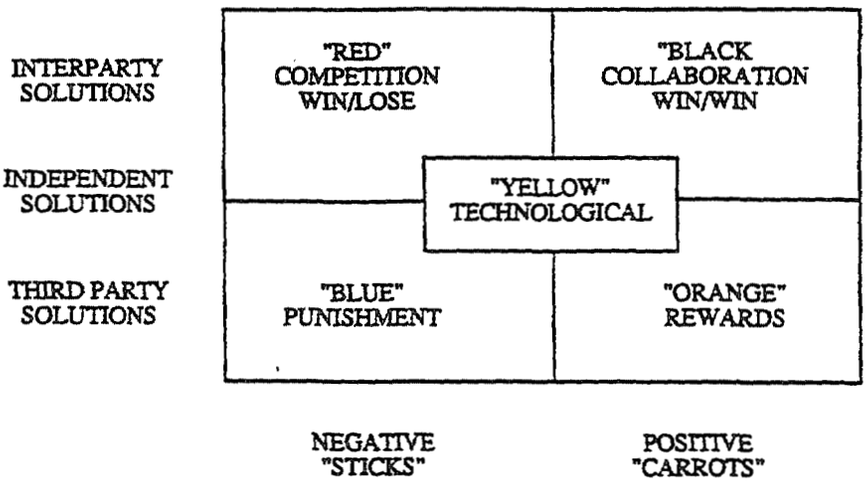
Each man is locked into a system that compels him to increase his head without limit--in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in freedom of the commons. Freedom in a commons brings ruin to all."

Hardin, G. 1968. Tragedy of the Commons, Science. 162: 1263-48

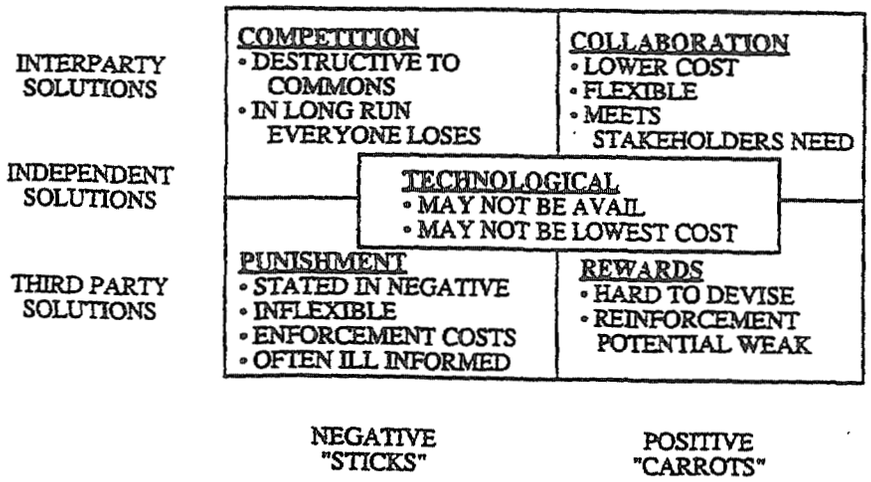
- WHAT IS A COMMONS?
  - EXAMPLES?
  - WHAT IS COMMONS IN SIMULATION?
  - EXAMPLES RELATED TO ENERGY?
- WHAT HAPPENED TO THE COMMONS?
- WHY DID THIS HAPPEN?
- UNDER WHAT CONDITIONS?
  - PROSPECT OF INDIVIDUAL GAIN FROM EXPLOITING COMMONS EXCEEDS COSTS...WHY?
  - INDEPENDENT CALCULUS WITH INTERDEPENDENT USAGE
  - ROLE OF DEVELOPMENT >>> see OVH
  - ABSENCE OF "MUTALLY COERCIVE" MECHANISMS AGAINST
- ARE TECHNICAL SOLUTIONS THE ANSWER TO COMMONS PROBLEMS?
- WHAT OTHER TYPES OF SOLUTIONS ARE POSSIBLE?

CONDITION OF COMMONS	PERCEIVED INDIV. BENEFITS	PERCEIVED INDIV. COSTS	SHARED SOCIAL COSTS
4			
3			
2			
1			
0			
-1			
-2			
-3			
-4			
-5			
-6			
-7			

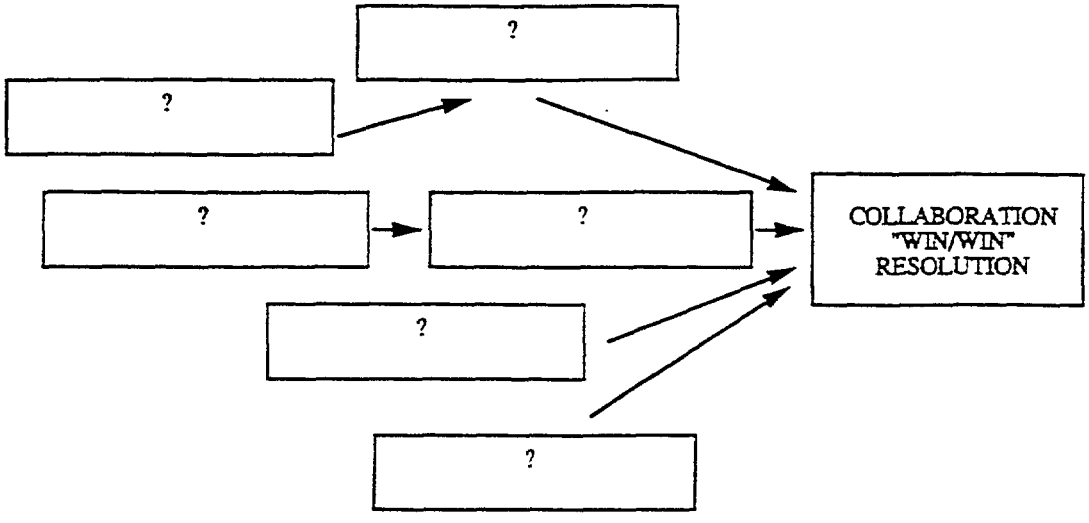
Interorganizational Postures in Commons Simulation



Merits of Various Approaches to Commons Problem

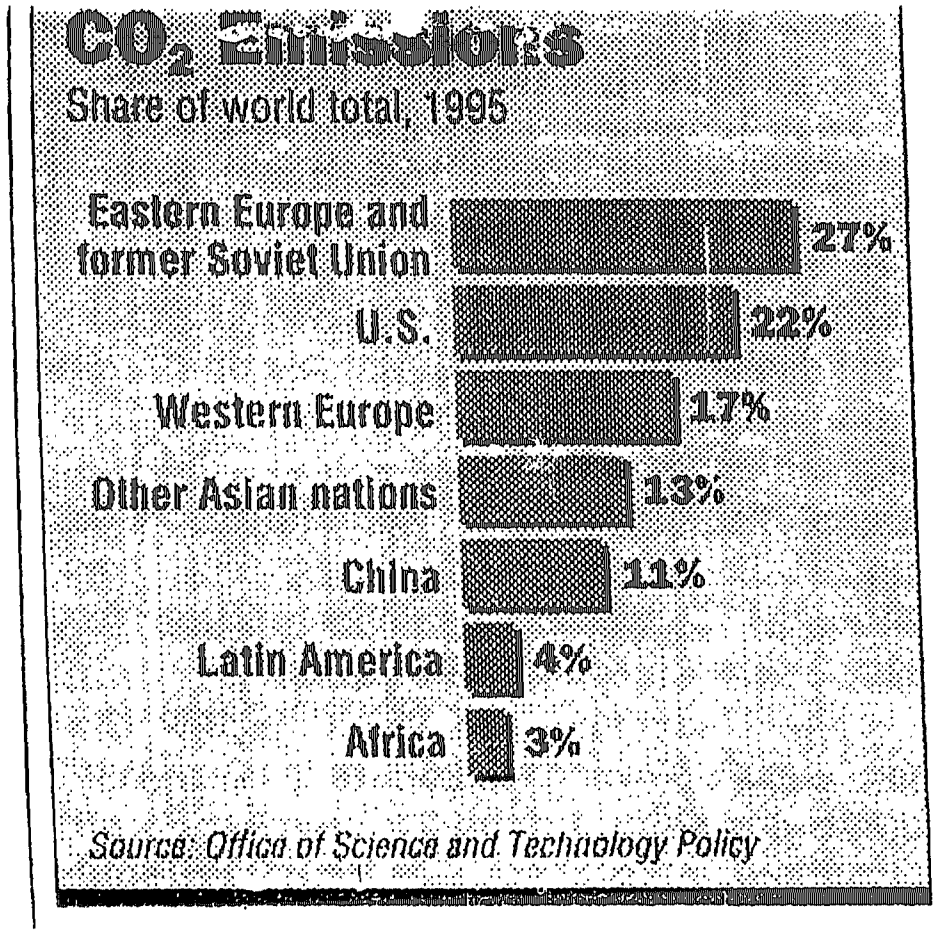


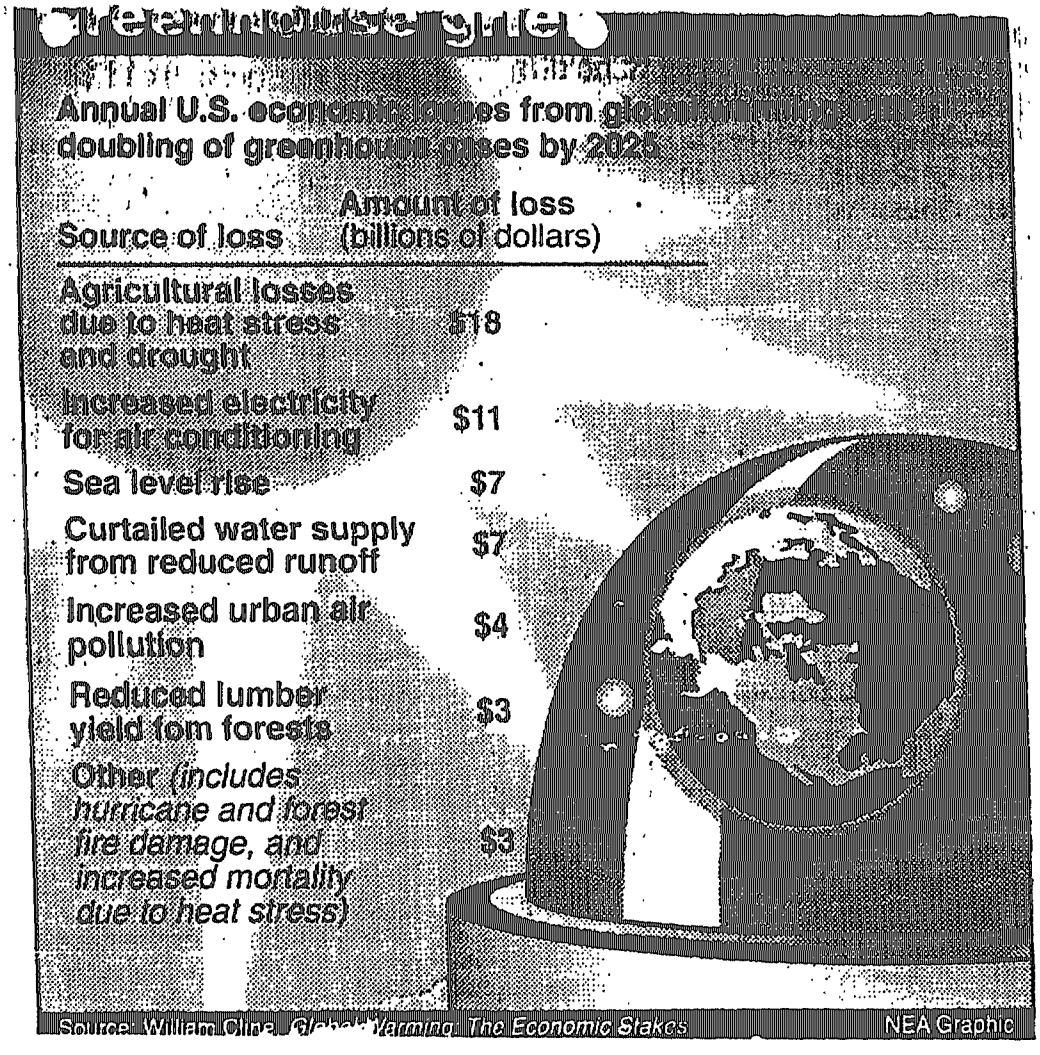
A MODEL PREDICTING COLLABORATION
FOR MAINTAINING THE "COMMONS"



REVIEW OF STRATEGIES FOR SAVING THE COMMONS

- PRIVATISATION -- Make it not a commons
- SUBSIDIZATION -- Public pays to mitigate social costs
- LEGAL RESTRICTIONS -- Limit access/use of commons)
  STATUTORY LAW
  ADMINISTRATIVE LAW
- MARKET INTERVENTIONS -- Incorporate social costs into economic calculus
- BEHAVIORAL CHANGE -- Educate people re: social costs, interdependence, & moral and ethical obligations
- INSTITUTION BUILDING -- Institutional arrangements to promote collaboration (e.g., industry associations; changes in corporate governance; stakeholder management; voluntary consensus standards)


CO_2 Emissions
Share of world total, 1995
Eastern Europe and former Soviet Union 27%
U.S. 22%
Western Europe 17%
Other Asian nations 13%
China 11%
Latin America 4%
Africa 3%
Source: Office of Science and Technology Policy


Greenhouse grief
Annual U.S. economic losses from global warming with doubling of greenhouse gases by 2025
Source of loss
Amount of loss (billions of dollars)
Agricultural losses due to heat stress and drought $18
Increased electricity for air conditioning $11
Sea level rise $7
Curtailed water supply from reduced runoff $7
Increased urban air pollution $4
Reduced lumber yield fom forests $3
Other (includes hurricane and forest fire damage, and increased mortality due to heat stress) $3
Source: William Cline, Global Warming: The Economic Stakes
NEA Graphic

Uzbeks Manage to Endure Amid Ruins of the Aral Sea

By HUGH POPE
Staff Reporter of THE WALL STREET JOURNAL

MUYNAK, Uzbekistan

THE ARAL SEA is going, gone. Once the world's fourth-largest inland body of water, the Aral has shriveled to half its former area and a third of its volume. As for the region's drinking water, even the local vodka has a salty tang.

The fate of the Karakalpak region of Uzbekistan at the southern end of the Aral Sea is like that shared by nearby Kazakstan and Turkmenistan. Here, because of wasteful farming techniques and uncontrolled water usage, more than 1.4 million people struggle with one of the world's most complete environmental disasters.

Muynak was once a prosperous fishing port and coastal trading post. But, the shoreline has retreated 50 miles from town and half of the 28,000 inhabitants have abandoned the streets and houses. Six of pensioner Disen Varbustinov's seven children joined the exodus. Like the others who remain, Mr. Varbustinov is determined to stick it out.

The former fish cannery worker even seized an opportunity as the sea retreated, building a comfortable new home with eight rambling rooms on the old seabed where there were once waves, storms and fishing boats drawn up on the beach. Now all around the house he somehow grows vegetable marrows, tomatoes and grapes in gray soil that looks like pure sand.

"I mix the sand with fertilizer. But you have to do the proportions carefully and look after it," Mr. Varbustinov says, showing a cracked tomato suffering from an overdose of fertilizer.

A tin canoe round the back of the house lies ready for fishing expeditions in the few canals with enough water left to float it. In front, Mr. Varbustinov shows off his invention of a rice dehusker made out of a big can, some knives and an old Soviet electric motor. His unorthodox stratagems echo those of Muynak's much-subsidized local government, even though experts doubt they are doing more than expensively buying time for the community.

The Amu Darya River, once one of the two main tributaries of the Aral, has now been completely dammed outside the town, far short of the sea. The dam channels water into a system of lakes that Muynak Gov. Otimurat Kalmuratov believes will boost inland fish farming beyond the 2,000 tons of fish now sent to the primitive canning factory. This is less than 10% of what was once produced in what is still the town's main employer.

"What we are doing is learning to live without the Aral Sea. We'll never get it back," Mr. Kalmuratov says, echoing the judgment of almost all involved in the catastrophe. "The problem is that we just don't get enough water, and what we do get is very salty." So salty, that it is about three times the level that even the salt-tolerant people of the region can drink.

Health problems here are enormous: perhaps double the Central Asian infant mortality rate and some of the highest rates of cancer and hepatitis. But the causes are difficult to isolate from factors more general to Central Asia, namely poverty, hunger, alcoholism and despair.

"People here don't know what a normal life is, otherwise they could not cope with the stress," says Oral Ataniyazova, a local health activist. She says nobody knows exactly what risks result from decades of heavy agricultural use of fertilizers, pesticides and defoliants, industrial heavy-metal pollution or even the testing of biological weapons in the Aral Sea area. "We live the Aral Sea crisis, but for us, that crisis is normal," Mrs. Ataniyazova says. "We are not in an ecological extreme. We are in an economic extreme. This is not a high-level crisis like the radiation from Chernobyl. It's a chronic exposure to low doses of chronic pollutants. As a biological subject, we can survive."

Survival for many species of Aral Sea fish has only been as pickled relics in the Muynak museum. In the frayed children's notebook that serves as a place for visitors's comments is one from the U.S. ambassador to Uzbekistan, Stanley Escudero, who notes that "the whole region will pay a high price if nothing is done."

The U.S. is already picking up some of the bill. It paid for a new chlorination system for Muynak's water, part of a $21 million program to help mitigate the crisis, which followed a visit by then-U.S. senator Al Gore. It has also posted an environmental officer to Central Asia, mainly to watch for political and environmental fallout in the 266,000-square mile basin.

The World Bank has also started a program worth more than $100 million to improve drinking water, sanitation and health on top of grants for ambulances, water trucks and support for orphanages. It also plans to spend hundreds of millions of dollars more on improving ruinous agricultural practices, such as over-irrigation that mixes fresh water with the briny aquifers, that lie at the heart of the Aral Sea crisis. After all, there is plenty of water, just not enough in the Aral Sea.

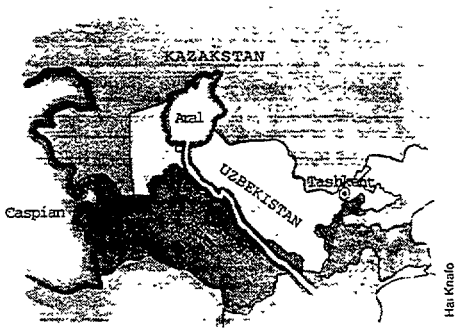
Outside Nukus, capital of Uzbekistan's Karakalpak region, the Amu Darya is now stagnant and 100 feet wide, mocking its old 1,000-yard-wide river bed. Cars clank across a metal pontoon bridge before climbing up the dirt bank where young boys and wiry old women sell a few pike-perch for about a dollar each.

These are the only commercial fish left. The region has little hope of fulfilling the planned cotton quotas from the Uzbek capital, Tashkent, and is finding precious little else to market. The chief of Karakalpak foreign economic relations, Kutlumurat Sultamurat, says that 1997's worst-ever water supplies crippled the rice crop. He talks of projects to make paper or chipboard out of rice husks and cotton bushes. He shows off some shelves displaying the few items the region can still produce: licorice roots, polished marble, simple cotton textiles and, last but not least, packaged salt.

On the dusty plain outside town, camels wander past Muynak's first integrated textile factory, where sun and salty winds have stripped the three-year-old coat of paint on the factory walls. Quality is still a constant problem: The short, seedy fibers of the local cotton and a lack of spare parts have idled nearly half the machines at one processing stage. Yarns kept breaking in the knitting machines, forcing constant stoppages.

None of this daunted local official Ghulam Rajapov, whose development program for a bakery, dairy, water-bottling plant and a factory to make baby food from rice was scuttled by the 1996 cotton-crop failure.

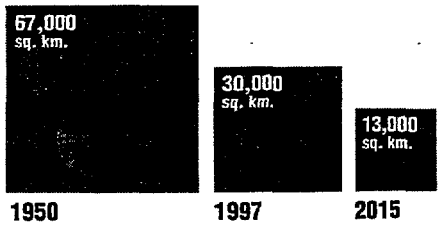
"When I go to Tashkent I have to put plenty of salt on my food and I find the water tastes kind of insipid," Mr. Rajapov jokes over an extravagant salty feast offered to a visitor. "And when I rinse my face, it's still covered with soap. At least here everything comes off with the water. And our canal fish are presalted."



Hal Knolo

Disen Varbustinov and his wife (top) and a look at the Aral Sea region

Shrinking Sea Surface area of the Aral Sea



Source: International Fund for Aral Sea, World bank

February 14, 1998

Module III

Advanced reading:

Changing Course: A Global Business Perspective on Development and the Environment

Changing Course
A Global Business Perspective on Development and the Environment

Stephan Schmidheiny
with the Business Council
for Sustainable Development

The MIT Press
Cambridge, Massachusetts
London, England

37

Schmidheiny, S.

"Changing Course"

1 The Business of Sustainable Development

"With greater freedom for the market comes greater responsibility."

Gro Harlem Brundtland
Prime Minister, Norway

Running a company requires daily assessments of opportunities, risks, and trends. Corporate leaders who ignore economic, political, or social changes will lead their companies toward failure. So too will those who overreact to change and perceived risk.

Many global trends offer hope. Life expectancy, health care, and education have all improved dramatically in the second half of this century. World food production has stayed well ahead of population growth. Average per capita incomes have increased by the highest sustained rates ever. No shortage of raw materials looms in the foreseeable future. Given the right technology, the planet's soils can supply more than the basic food needs of much larger populations.

But neither business nor any other leaders can afford to see only the positive, especially when these optimistic signs are based on averages that mask alarming departures from the norm. Several other linked global trends demand any thinking person's attention. Each is replete with scientific uncertainty. To overreact to any of these would be dangerous, but to ignore any of them would be irresponsible.

First, the human population is growing extremely rapidly; according to the most optimistic estimates, an already crowded planet is likely to have to support twice as many people next century. Environmental ills have varying causes, but all are made worse by the pressure of human numbers.

Second, the last few decades have witnessed an accelerating consumption of natural resources—consumption that is often inefficient and ill planned. Resources that biologists call renewable are not being given

time to renew. The bottom line is that the human species is living more off the planet's capital and less off its interest. This is bad business.

Third, both population growth and the wasteful consumption of resources play a role in the accelerating degradation of many parts of the environment. Productive areas are hardest hit. Agriculturally fruitful drylands are turning into desert; forests into poor pastures; freshwater wetlands into salty, dead soils; rich coral reefs into lifeless stretches of ocean.

Fourth, as ecosystems are degraded, the biological diversity and genetic resources they contain are lost. Many environmental trends are reversible; this loss is permanent.

Fifth, this overuse and misuse of resources is accompanied by the pollution of atmosphere, water, and soil—often with substances that persist for long periods. With a growing number of sources and forms of pollution, this process also appears to be accelerating. The most complex and potentially serious of these threats is a change in climate and in the stability of air circulation systems.

There are also alarming trends apparent in patterns of "development"; these, too, begin with population projections. More than 90 percent of population growth takes place in the developing world—that is, in poorer countries.[1] This means that when the present world population of more than 5 billion doubles next century, there will be an extra 4.5 billion people in nations where today it is hardest to secure jobs, food, safe homes, education, and health care.

Already, population growth means that the number of people who belong to the underclass—those unable to secure such basics of life as adequate food, shelter, clothing, health care, and education—is rising yearly in much of the developing world. In the mid-1980s more than a billion people on the planet, almost a third of the population of the developing world, were trying to survive on an income equivalent to about $1 per day.[2]

Poverty, rapid population growth, and the deterioration of natural resources often occur in the same regions, creating a huge imbalance between the quarter of the planet living in rich, industrial nations and the three quarters residing in developing nations. The national income of Japan's 120 million people is about to overtake the combined incomes of the 3.8 billion people in the developing world.[3] The industrial nations have generally cut their aid to the developing world. And because of debt

servicing and repayment and reduced foreign investment, total capital flows were reversed in the second half of the 1980s, with money flowing from poor to rich.

These two sets of alarming trends—environment and development—cannot be separated. Economic growth in most of the developing world will depend for some time on agricultural production, so a reduction in the productivity in ecosystems tends to mean declining farm production and loss of revenue. But increasing populations in stagnant economies mean that more people are directly relying on the environmental resource base for a living. Environmental and economic decline are in many areas an inseparable part of the same downward spiral.

The resulting global structural challenge was concisely summed up by Maurice Strong, Secretary General of the U.N. Conference on Environment and Development in Brazil in June 1992: "The gross imbalances that have been created by concentration of economic growth in the industrial countries and population growth in developing countries is at the centre of the current dilemma. Redressing these imbalances will be the key to the future security of our planet—in environmental and economic as well as traditional security terms. This will require fundamental changes both in our economic behavior and our international relations."[4]

Clearly action is required. But which actions, and when, given the huge uncertainties involved? This is the sort of issue that business copes with daily. Corporate leaders are used to examining uncertain, negative trends, making decisions, and then taking action, adjusting, and incurring costs to prevent damage. Insurance is just one example. There are costs involved, but these are costs the rational are willing to bear and costs the responsible do not regret, even if things turn out not to have been as bad as they once seemed. We can hope for the best, but the "precautionary principle" remains the best practice in business as well as in other aspects of life.

This principle was agreed to at the World Industry Conference on Environmental Management in 1984 and at the 1989 Paris summit of the leaders of the seven richest industrial nations (the G7). It was strengthened in the Ministerial Declaration of the 1990 U.N. Economic Commission for Europe meeting in Bergen: "In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or

irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."[5]

Yet risk and uncertainty are usually accompanied by new opportunities, and business has long been adept at seizing such chances. For example, using energy more efficiently, and thus reducing global and local pollution, decreases costs and increases competitiveness. Many of what politicians and economists call "no regrets policies"—actions that make sense no matter what the real threat of global warming—are from a business point of view opportunities and good investments; examples include improving energy efficiency and developing new energy sources, new drought-resistant crops, and new resource management techniques.

There will be many opportunities for business. Having researched various aspects of competitive advantage among nations, Harvard Business School Professor Michael Porter reported: "I found that the nations with the most rigorous [environmental standards] requirements often lead in exports of affected products....The strongest proof that environmental protection does not hamper competitiveness is the economic performance of nations with the strictest laws." He mentions the successes of Japan and Germany, as well as that of the United States in sectors actually subject to the greatest environmental costs: chemicals, plastics, and paints.[6]

Viewing environmental threats from a business perspective can help guide both governments and companies toward plausible policies that offer protection from disaster while making the best of the challenges.

This book is about the steps required of business, and of the governments that set the frameworks for industry, to ensure that humans and all other species continue to occupy a safe and bountiful planet.

Sustainable Development

During the first great wave of environmental concern in the late 1960s and early 1970s, most of the problems seemed local: the products of individual pipes and smokestacks. The answers appeared to lie in regulating these pollution sources.

When the environment reemerged on the political agenda in the 1980s, the main concerns had become international: acid rain, depletion of the ozone layer, and global warming. Analysts sought causes not in pipes

> *"This is the moment of truth for Western Europe and the industrialized world. Will we prove to be strong enough and refrain from part of our own consumption in order to secure a peaceful and democratic development in Eastern Europe? Will we be able to give hope to all the poor, who for so long have been oppressed by an inhuman system and denied economic development as well as an acceptable environment?"*
>
> Percy Barnevik
> Chief Executive Officer
> ABB Asea Brown Boveri Ltd.

and stacks but in the nature of human activities. One report after another concluded that much of what we do, many of our attempts to make "progress," are simply unsustainable. We cannot continue in our present methods of using energy, managing forests, farming, protecting plant and animal species, managing urban growth, and producing industrial goods. We certainly cannot continue to reproduce our own species at the present rate.

Energy provides a striking example of present unsustainability. Most energy today is produced from fossil fuels: coal, oil, and gas. In the mid-1980s, the world was burning the equivalent of 10 billion metric tons of coal per year, with people in industrial nations using much more than those of the developing world. At these rates, by 2025 the expected global population of more than 8 billion would be using the equivalent of 14 billion metric tons of coal. But if all the world used energy at industrial-country levels, by 2025 the equivalent of 55 billion metric tons would be burned. Present levels of fossil fuel use may be warming the globe; a more than fivefold increase is unthinkable. Fossil fuels must be used more efficiently while alternatives are being developed if economic development is to be achieved without radically changing the global climate.[7]

Given such widespread evidence of unsustainability, it is not surprising that the concept of "sustainable development" has come to dominate the environment/development debate. In 1987, the World Commission on Environment and Development, appointed three years earlier by the U.N. General Assembly and headed by Norwegian Prime Minister Gro Harlem Brundtland, made sustainable development the theme of its entire report, *Our Common Future*. It defined the concept simply as a form

of development or progress that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[8]

The phrase itself can be misleading, as the word development might suggest that it is a chore for "developing" nations only. But development is more than growth, or quantitative change. It is primarily a change in quality. More than a decade ago, the influential World Conservation Strategy, compiled by the United Nations and organizations representing governments and private bodies, defined development as "the modification of the biosphere and the application of human, financial, living and non-living resources to satisfy human needs and improve the quality of human life."[9]

Thus all nations are, or would wish to be, developing. And sustainable development will require the greatest changes in the wealthiest nations, which consume the most resources, release the most pollution, and have the greatest capacity to make the necessary changes. These nations must also respond to the criticism from many leaders in the poor parts of the world that industrial countries risk reversing the relationship between production and the satisfaction of needs. They charge that increased production in wealthy nations no longer serves primarily to satisfy needs; rather, the creation of needs serves to increase production.

The idea that much of what humanity does in the name of progress is unsustainable and must be changed has gained rapid acceptance. In 1987, the U.N. General Assembly passed a resolution adopting the World Commission's report as a guide for future U.N. operations, and commending it to governments. Since then, many governments have tried to bend their policies to its recommendations. The July 1989 G7 summit called for "the early adoption, worldwide, of policies based on sustainable development."[10]

Business has also taken up the challenge, at the international, national, and sectoral levels. The International Chamber of Commerce drafted a "Business Charter for Sustainable Development," which was launched in April 1991 at the Second World Industry Conference on Environmental Management. The Charter, endorsed by 600 firms worldwide by early 1992, encourages companies to "commit themselves to improving their environmental performance in accordance with these [the Charter's] 16 Principles, to having in place management practices to effect such improvement, to measuring their progress, and to reporting this progress as appropriate internally and externally."[11]

The senior business group in Japan, the Keidanren, adopted an Environmental Charter in 1991 that sets out codes of behavior toward the environment.[12] Malaysia has established a corporate environmental policy that calls on companies "to give benefit to society; this entails...that any adverse effects on the environment are reduced to a practicable minimum."[13] The Confederation of Indian Industry has also urged an "Environment Code for Industry" upon its members.[14]

Chemical industry associations in several countries have agreed to a Responsible Care program to promote continuous improvement in environmental health and safety. Begun in Canada and taken up in the United States, Australia, and many European countries, the scheme encourages associations to draft codes of conduct in many areas of operations, and it recommends that large companies help smaller ones with environmental and safety improvements.[15]

Sustainable development will obviously require more than pollution prevention and tinkering with environmental regulations. Given that ordinary people—consumers, business people, farmers—are the real day-to-day environmental decision makers, it requires political and economic systems based on the effective participation of all members of society in decision making. It requires that environmental considerations become a part of the decision-making processes of all government agencies, all business enterprises, and in fact all people. It requires levels of international cooperation never before achieved, not least in agreeing to and enforcing treaties to manage global commons such as the atmosphere and oceans. It requires, beyond immediate environmental concerns, an end to the "arms culture" as a method of achieving security, and new definitions of security that include environmental threats.

Recently the nations of the world seem to have begun to move, albeit slowly, in these directions. Environmental concern has gradually begun to infuse all areas of decision making. Democracy has become a more prevalent form of government throughout the developing world, Eastern Europe, and the former Soviet Union. The Montreal protocol on the ozone layer and an emerging treaty on the atmosphere suggest that nations may be able to cooperate along the harder paths toward a cleaner global environment. Definitions of security are changing, and the end of the cold war may free resources for work on environmental security.

Will these changes last, and are they happening fast enough?

The Growth Controversy

Perhaps the most controversial conclusion of the World Commission was that sustainable development requires rapid economic growth. This assumption is based on the reality that growing populations and poor populations require goods and services to meet essential needs and that "meeting essential needs depends in part on achieving full growth potential, and sustainable development clearly requires economic growth in places where such needs are not being met. Elsewhere, it can be consistent with economic growth, provided the content of growth reflects the broad principles of sustainability and non-exploitation of others."[16]

There are critics who argue that the limits to economic growth have already been reached and there must be "zero growth" from now on. Some of them do not explain how zero growth will meet the needs of a planet with more than 10 billion people. But others who feel that the environmental limits to growth have been reached, such as Robert Goodland and Herman Daly of the World Bank's Environment Department, argue that "development by the rich must be used to free resources...for growth and development so urgently needed by the poor. Large-scale transfers to the poorer countries also will be required."[17]

The World Commission itself noted that growth alone is not enough, as high levels of productivity and widespread poverty can coexist and can endanger the environment. So sustainable development requires societies to meet human needs both by increasing environmentally sustainable production and "by ensuring equitable opportunities for all."[18]

The Commissioners argued that growth was limited at present by both the nature of technologies and the nature of social organization. For example, humanity will eventually be using much more energy than today, but an increasing part will have to come from sources other than fossil fuels. And if societies remain organized so that many people remain impoverished despite sustained economic growth, then this poverty will both degrade environmental resources and eventually act as a brake on growth.

The Business Challenge

The requirement for clean, equitable economic growth remains the biggest single difficulty within the larger challenge of sustainable development.

Proving that such growth is possible is certainly the greatest test for business and industry, which must devise strategies to maximize added value while minimizing resource and energy use. Given the large technological and productive capacity of business, any progress toward sustainable development requires its active leadership.

Open, prospering markets are a powerful force for creating equity of opportunity among nations and people. Yet for there to be equal opportunity, there must first be opportunity itself. Open, competitive markets create the most opportunities for the most people. It is often the nations where markets most closely approach the ideal of "free," open, and competitive that have the least poverty and the greatest opportunity to escape from that poverty.

The World Commission listed as the first prerequisite for sustainable development a political system in which people can effectively participate in decision making. But freedom to participate in political decisions and freedom to participate in markets are inseparable over the long run. The citizens of Central Europe, having achieved political freedom, are now building market freedom. The Asian nations that achieved thriving market economies under authoritarian regimes are now moving toward more democratic governments.

Yet no market can be called "free" in which the decisions of a few can cause misuse of resources and pollution that threaten the present and future of the many. Today, for instance, the earth's atmosphere is providing the valuable service of acting as a dump for pollutants; those enjoying this service rarely pay a reasonable price for it.

"Eco-efficiency"

The present limits to growth are not so much those imposed by resources, such as oil and other minerals, as was argued by the 1972 Club of Rome report *The Limits to Growth*.[19] In many cases they arise more from a scarcity of "sinks," or systems that can safely absorb wastes. The atmo-

> *"We believe a business cannot continue to exist without the trust and respect of society for its environmental performance."*
>
> Shinroku Morohashi
> President
> Mitsubishi Corporation

sphere, many bodies of water, and large areas of soil are reaching their own absorptive limits as regards wastes of all kinds.

Business has begun to respond to this truth. It is moving from a position of limiting pollution and cleaning up waste to comply with government regulations toward one of avoiding pollution and waste both in the interests of corporate citizenship and of being more efficient and competitive. The economies of the industrial countries have grown while the resources and energy needed to produce each unit of growth have declined. Chemical companies in industrial nations have doubled output since 1970 while more than halving energy consumption per unit of production.[20]

Industry is moving toward "demanufacturing" and "remanufacturing"—that is, recycling the materials in their products and thus limiting the use of raw materials and of energy to convert those raw materials. (See chapter 7.) That this is technically feasible is encouraging; that it can be done profitably is more encouraging. It is the more competitive and successful companies that are at the forefront of what we call "eco-efficiency."

But eco-efficiency is not achieved by technological change alone. It is achieved only by profound changes in the goals and assumptions that drive corporate activities, and change in the daily practices and tools used to reach them. This means a break with business-as-usual mentalities and conventional wisdom that sidelines environmental and human concerns.

A growing number of leading companies are adopting and publicly committing themselves to sustainable development strategies. They are expanding their concepts of who has a stake in their operations beyond employees and stockholders to include neighbors, public interest groups (including environmental organizations), customers, suppliers, governments, and the general public. They are communicating more openly

with these new stakeholders. They are coming to realize that "the degree to which a company is viewed as being a positive or negative participant in solving sustainability issues will determine, to a very great degree, their long-term business viability," in the words of Ben Woodhouse, director of Global Environmental Issues at Dow Chemical.

The Challenge of Time

As the World Commission noted, sustainable development requires forms of progress that meet the needs of the present without compromising the ability of future generations to meet their own needs. In the late twentieth century, we are failing in the first clause of that definition by not meeting the basic needs of more than 1 billion people. We have not even begun to come to grips with the second clause: the needs of future generations. Some argue that we have no responsibility for the future, as we cannot know its needs. This is partly true. But it takes no great leap of reason to assume that our offspring will require breathable air, drinkable water, productive soils and oceans, a predictable climate, and abundant plant and animal species on the planet they will share.

Yet it is a hard thing to demand of political leaders, especially those who rely on the votes of the living to achieve and remain in high office, that they ask those alive today to bear costs for the sake of those not yet born, and not yet voting. It is equally hard to ask anyone in business, providing goods and services to the living, to change their ways for the sake of those not yet born, and not yet acting in the marketplace. The painful truth is that the present is a relatively comfortable place for those who have reached positions of mainstream political or business leadership.

This is the crux of the problem of sustainable development, and perhaps the main reason why there has been great acceptance of it in principle, but less concrete actions to put it into practice: many of those with the power to effect the necessary changes have the least motivation to alter the status quo that gave them that power.

When politicians, industrialists, and environmentalists run out of practical advice, they often take refuge in appeals for a new vision, new values, a new commitment, and a new ethic. Such calls often ring hollow and rhetorical. But given that sustainable development requires a practical concern for the needs of people in the future, then it does ultimately

require a new shared vision and a collective ethic based on equality of opportunity not only among people and nations, but also between this generation and those to come. Sustainability will require new technology, new approaches to trade to spread the technology and the goods necessary for survival, and new ways of meeting needs through markets. Business leadership will be required, and expected, in all these areas.

However, sustainable development will ultimately be achieved only through cooperation among people and all their various organizations, including businesses and governments. And leaders elected to decision-making and executive offices retain a fundamental obligation to inform and educate their constituencies about the urgent necessity and the reasons for changing course.

We believe that the best aspects of the human propensity to buy, sell, and produce can be an engine of change. Business has helped to create much of what is valuable in the world today. It will play its part in ensuring the planet's future.

Shaping the Future

The inevitable process of change toward sustainable forms of development will determine the future course of human civilization and shape our life-styles and thereby the way we do business. Yet many business leaders have so far been relatively passive in dealing with these issues.

Perhaps this ultimately has to do with the way we each react to the dimension of time. Those who have little interest in the future of nature and humanity will have little regard for the sustainability of their actions and will not be concerned to grapple with and understand the challenges facing us all. Those who do care about society and its progress have learned to understand that business never operates in a vacuum. It interacts at many levels with society, and society is now entering a period of rapid and fundamental changes.

Business has developed remarkable skills in market intelligence to spot and to a certain extent predict changing demand patterns. It must also construct a system of "social intelligence" to spot, understand, and interpret signals of change in development patterns. Those who are quickest to receive and act on such signals will have a great advantage over competitors who react only when changes in society become apparent in the form of changed consumer habits.

The environmental chal enge has grown from local pollution to global threats and choices. The l usiness challenge has likewise grown—from relatively simple technica fixes and additional costs to a corporatewide collection of threats, choic s, and opportunities that are of central importance in separating tomori w's winners from tomorrow's losers. Corporate leaders must take thi into account when designing strategic plans of business and deciding ie priorities of their own work.

Sustainable developme t is also about redefining the rules of the economic game in order t move from a situation of wasteful consumption and pollution to one c conservation, and from one of privilege and protectionism to one of fa and equitable chances open to all. Business leaders will want to parti pate in devising the rules of the new game, striving to make them sin le, practical, and efficient.

No one can reasonably d ubt that fundamental change is needed. This fact offers us two basic op ons: we can resist as long as possible, or we can join those shaping the ature. *Changing Course* is an invitation and a challenge to business lead rs to choose the more promising and more rewarding option of partic pation.

2 Pricing the Environment: Markets, Costs, and Instruments

"Bureaucratic socialism collapsed because it did not allow prices to tell the economic truth. Market economy may ruin the environment and ultimately itself if prices are not allowed to tell the ecological truth."

Ernst U. von Weizsäcker
Institut für Klima, Umwelt + Energie GmbH
(Institute for Climate, Environment, and Energy)

The cornerstone of sustainable development is a system of open, competitive markets in which prices are made to reflect the costs of environmental as well as other resources.

This assertion is the basis of much that follows in our book, and we hold it to be true for many reasons. Sustainable development requires the production of increasing amounts of goods and services to meet the needs of rapidly growing numbers of people. At the same time, the use of environmental resources must become more efficient, and production processes and consumption patterns must release less pollution. Given that production and pollution are influenced by the daily activities of billions of people, sustainable development cannot be secured efficiently by government decisions alone. Governments should instead provide the framework in which it can happen.

Open markets can motivate people toward sustainable development. When resources are priced properly, the pursuit of competitiveness encourages producers to minimize resource use. To the extent that pollution represents resources that have "escaped" from a production system, the concern for costs will also encourage producers to minimize pollution, especially when they pay to control it or are made liable for damage it causes. The competition inherent in open markets is the primary driving force for the creation of new technology. And new

technology is needed to use resources more efficiently and further reduce pollution. Inasmuch as the development of technology also depends on economic growth, so, then, does sustainable development.

Open, competitive markets create jobs and opportunities, and thus are the most effective way of meeting people's needs. Accessible markets empower people, and offer the greatest opportunities to the poor. Free markets are also inseparable from the other forms of freedom sweeping the planet at the close of the twentieth century, not only in Eastern Europe but also in Latin America, Africa, and Asia. The barriers against citizens' effective participation in markets are a major reason for the failure of centrally planned economies in Eastern Europe and the slow, faltering development of many developing nations.

But the fall of communism does not represent the total victory of capitalism. It is merely the end of a system that, as practiced in Eastern Europe and in the Soviet Union, reflected neither economic nor environmental truths. This should encourage those of us who believe in the efficacy of the marketplace to eliminate its failures and weaknesses and to build on its strengths. Market economies must now rise to the challenge and prove that they can adequately reflect environmental truth and incorporate the goals of sustainable development.

Making Markets Work for the Environment

If markets really do encourage efficient resource use and decreases in pollution, then we must ask ourselves why the past record of industrialization is largely one of unsustainable resource use and high levels of pollution.

The primary answer is that markets have simply not efficiently reflected the costs of environmental degradation. They often fail to integrate environmental costs into economic decisions—at either the business or the government level. These costs are called "externalities." They traditionally do not enter into cost calculations other than through environmental regulations, many of which do not go far enough and which are unnecessarily burdensome to consumers and industry. For example, a coal-fired power plant that releases pollution plays a role in damaging human health, corroding the built environment, killing forests, and acidifying lakes. There is nothing theoretical about the costs of

this damage. But they are spread throughout society and are external to the operations of the power plant.

For nations to factor these externalities into the costs of doing business is probably the most important correction necessary in current market systems. This basic defect can be mended by a variety of instruments. Indeed, many businesses and many governments have already started the process. Many existing environmental laws are a means of internalizing environmental costs. Ultimately, however, businesses and governments must undertake the process in an internationally harmonized manner and at least begin to move in the same direction, so that the global marketplace offers the same information, the same rules of competition, and therefore the same openness and opportunities for all participants.

"Full-Cost Pricing"

Including environmental costs in the accounts of business is often referred to as "full-cost pricing." This is a theoretical abstraction, an ideal. Like other powerful ideals, such as democracy and the concept of the "free market" itself, its approximation will vary under different conditions in different times and places.

Economists are working to establish the "full cost" of various types of pollution and other environmental damage. Although this work is useful, some costs cannot be quantified accurately. For example, in the case of global pollution problems such as ozone depletion, the full cost remains an abstraction because the price of destroying the planet's ozone layer cannot be accurately estimated. But the feared health impacts of ozone loss by themselves encouraged acts of control. The task of internalizing environmental costs must proceed using imperfect, existing knowledge and imperfect, available tools.

The lack of accuracy in determining the actual and future costs of pollution should not allow us to conclude that no price can be established at all. As individuals set prices for privately owned goods, society must establish through political processes prices for the use of goods held in common: waters, atmosphere, and so on. This work must be based both on the best available scientific evidence and on people's preferences and choices.

The market does not tell us where to go, but it provides the most efficient means of getting there. Therefore, society—through its political systems—will have to make value judgments, set long-term objectives, implement measures such as charges and taxes step by step, and make midcourse corrections based on experience and changing evidence. Thus in moving toward sustainable development, it may be sufficient merely to introduce environmental charges slowly but predictably. Infrastructure planning, technology development, cultural patterns, and consumers could then anticipate the price increase and react accordingly.

The basic equations behind full-cost pricing are simple. For production, whether industrial or agricultural, the full cost is the cost of production plus the cost of any environmental damage associated with it. For use of resources, such as minerals or forests, the full cost is the cost of extraction plus the cost of environmental damage. For example, clearing a forest might degrade environmental services provided by that forest, such as protecting a watershed.

Resource extraction, manufacturing, and energy use and consumption levels are all affected by cost considerations. What is extracted, produced, and consumed depends on price. The higher the price, the lower the demand. This basic economic principle applies to the environment as well as to commercial transactions. When there is no or only a small charge to either individuals or corporations for dumping waste into the environment, more waste will be dumped than would be the case if prices reflected the full cost of disposal.

Possibly the most important factor in an effective pursuit of sustainable development is "getting the price right." Unless prices for raw materials and products properly reflect the social costs, and unless prices can be assigned to air, water, and land resources that presently serve as cost-free receptacles for the waste products of society, resources will tend to be used inefficiently and environmental pollution will likely increase.

Many production, extraction, and distribution processes do not even pay the economic costs of the activity (land, labor, and capital costs), much less the added costs of environmental damage. This is because elements of these activities are subsidized. Subsidies that degrade the environment are not a market failure but a policy failure. In many industrial nations, some forms of energy and transport, water, and some agricultural products are on the market for a price less than their cost. In other cases, prices are kept far above economic costs, encouraging wasteful oversupply (as with farm surpluses) and environmentally damaging, overintensive methods of production. In many developing

countries, energy, water, land, and agricultural inputs such as pesticides tend to be available at less than cost. The effect is wasteful overuse, resulting in increasing pollution and salinization of soils.

These subsidies have been introduced for a variety of political and social reasons over time, with little coordination of their impacts. Their beneficiaries—whether they be farmers, miners, corporations, or consumers—are all voters and have gotten used to the support they provide. Removing a subsidy is usually more difficult than introducing one. Because the process of eliminating subsidies creates adjustment problems, the financial resources currently used to support those that contribute to environmental problems should be redirected to financing the adjustment process of phasing them out.

The Polluter Pays Principle

Although the concept of internalizing costs is understood within the theory of economics, its realization becomes controversial in the real world. But one aspect of the debate has moved at least to the stage of international agreement.

As early as 1972 the members of the Organisation for Economic Co-operation and Development (OECD) agreed to the "Polluter Pays Principle" (PPP), which states that polluters should bear the full costs of any damage caused by the production of goods and services. This precept has gained wide recognition in both industrial and developing countries. Since the OECD policy allows any mechanism used to internalize costs to be counted toward meeting the PPP, much of the existing environmental regulation is consistent with the principle. Yet its implementation remains imprecise and somewhat ad hoc.

Although it still raises questions of what the real costs are, the point of departure of any attempt to internalize environmental costs must be this principle endorsed by all OECD members 20 years ago. In moving more systematically to the introduction of the Polluter Pays Principle, we urge governments to distinguish between easily identified costs and those impacts that pose complex questions of valuation. Progress on the former should not be delayed by debate on the latter. Where the economic impacts of this principle are significant and disruptive, a transition approach with identified end costs should be used. Governments also

must clarify issues of the costs of past damage, which are not implicitly covered by the PPP.

It is often argued that it is not the "polluter," in the form of the producer, who pays, but that part of the cost is passed along to the consumer. But this was the point of the principle from its very inception. Though there are various types of pollution charges and they have various primary objectives, most result in higher product prices. Higher prices for more environmentally damaging products send a market signal to the consumer to seek a cleaner substitute. As consumers respond, so do producers. The Polluter Pays Principle is meant to affect the choices of consumers. Open, competitive markets ensure that industry reacts to changes in consumer demand swiftly and efficiently.

Inducing Change

Three basic mechanisms can be used to move business to internalize environmental costs, to pay for the costs of pollution, or to limit damage to the environment by other means:

- *Command and control:* These are basically government regulations, including performance standards for technologies and products, effluent and emission standards, and so on.
- *Self-regulation:* These are initiatives by corporations or sectors of industry to regulate themselves through standards, monitoring, pollution reduction targets, and the like.
- *Economic instruments:* These are efforts to alter the prices of resources and of goods and services in the marketplace via some form of government action that will affect the cost of production and/or consumption.

Command and Control

Traditionally, governments have used command-and-control regulations to achieve environmental objectives. "Performance standards" set a target—often for emissions—and allow companies flexibility in meeting it; "prescriptive standards" may prescribe the actual technology to be used, assuming that it will achieve the desired result. The former allow companies more scope for innovation and efficiency.

There are emerging concerns, however, shared by both governments and industry about the useful limits and constraints associated with the regulatory approach:

- Regulations are inflexible and often not the most cost-effective way of achieving change.
- Regulation requires adherence to specific requirements (such as air filters), as opposed to continuous improvement and continuous innovation, so it tends to perpetuate rather than improve the state of the art.
- The regulatory approach poses particular problems for developing countries, where the required administrative infrastructure to assure compliance may not be sufficient for the task.

Our view is that regulations have served a useful purpose and that there will continue to be a need for a basic regulatory framework in all countries. Command and control is particularly useful when there is a serious threat to health or safety or when pollution becomes especially dangerous once it exceeds a given level locally.

Self-Regulation

Self-regulation has achieved and will continue to achieve important improvements in the environmental impacts of business and industry. But for it to work and be credible, a clear framework of expectations and requirements must be negotiated between participating industries and government. Within such a framework, industry will be free to innovate and compete.

Various forces drive industry toward self-regulation:

- the threat of government regulation (which requires a government with a proven regulatory apparatus);
- solicited voluntary initiatives (akin to the threat of regulation, in which the regulatory body "encourages" a company to take certain environmental initiatives);
- required disclosure of environmental effects (this is based on a government regulation, but is relatively inexpensive for both governments and companies);

- public pressure or public esteem (industries operate with an implied contract with the public; loss of confidence cannot long be tolerated);
- peer pressure (leading companies are adopting sustainable development charters, which puts pressure on others to do likewise);
- a common view of common threats (industrialists are people too, and take seriously threats to the human environment and human well-being that ordinary citizens worry about); and
- consistency of behavior by multinational corporations (international media communications means that multinational corporations receive intense scrutiny; this provides both an opportunity and an obligation to use consistently high standards in all operations).[1]

Self-regulation may prove cheaper to society in general than either command-and-control regulations or economic instruments. Industry often holds the information on technologies and emissions that government needs to regulate effectively. Self-regulation thus to some extent avoids the expense of governments collecting that information, processing it into regulations, and then monitoring the effect. Obviously, there will still be information gathering and monitoring by governments, even in a system of extensive self-regulation, but it should be less adversarial and less extensive, and therefore cheaper.

Self-regulation does, however, have its drawbacks. It could lead to the creation of cartels and protectionism. And it can be frustrated by "free rider" companies using noncompliance to gain unfair competitive advantage. One response to this problem is simply to rely on market forces; many free riders will suffer the consequences of noncompliance because the ecologically sound behavior agreed to by the self-regulating companies is sound business behavior. Alternatively, complying companies and industry trade associations that foster self-regulation can exert pressure on free riders, or they can ask governments to introduce regulations based on the companies' or associations' own model.

Economic Instruments

The growing interest in the use of economic instruments stems from four needs: to provide continuous rewards and incentives for continuous improvements, to use markets more effectively in achieving environmental objectives, to find more cost-effective ways for both government

> *"While maintaining a market economy, the government needs to change the signals so that sustainable development becomes possible. Not everything can be achieved by regulations. It is important to bring about responsible behavior through incentives, such as taxes on energy consumption and clean water instead of on employment and the creation of wealth."*
>
> Eugenio Clariond Reyes
> Presidente Ejecutivo
> Grupo IMSA, S.A.

and industry to achieve these same objectives, and to move from pollution control to pollution prevention.

There is no clear, agreed definition of what constitutes an economic instrument, but all of them involve intervention by government in the marketplace through mechanisms such as pollution taxes and charges, tradable pollution permits and resource quotas, deposit-refund systems (as with glass bottles), performance bonds, resource saving credits, differential prices (as with unleaded versus leaded gasoline), special depreciation provisions, and the removal of subsidies and barriers to market activity.[2]

Many of these instruments raise revenue. In fact, some are designed for that very purpose, especially administrative charges or fees meant to pay the costs of a pollution control program. But their main purpose is to change behavior through a charge or tax that acts as an economic incentive or disincentive to alter conduct. (Although the words tax and charge are often used interchangeably, a tax is usually a levy meant to raise general government revenue, while a charge raises revenue to finance a given program. Water charges, for example, are usually used to pay for some aspect of water supply, such as purification.)

We feel that, as a general principle, the introduction of economic instruments should be guided by the doctrine of "fiscal neutrality": that is, the revenue does not increase overall government revenues. Revenue raised above and beyond funds needed to finance a given program can be recycled for other purposes, such as reducing taxes on such things as employment, investment, income, and savings. Where instruments prove

regressive, affecting the poor disproportionately, then part of the revenues can be used to correct this effect.

Also, the introduction of economic instruments should be accompanied by a parallel package of measures designed to encourage the desired change in behavior. Pricing unleaded below leaded fuel is more effective, for example, if it is accompanied by policies encouraging car manufacturers to produce cars that run on unleaded, petroleum companies to offer unleaded at all gas stations, and environmental groups to educate motorists about converting old cars so they can use unleaded.

For an economic instrument to work, it must affect behavior. This means that it must move toward a threshold level of cost that will make polluters and consumers change their decisions about which processes to use and which products to buy.

A government requirement that information be made public comes under the heading of a market instrument because it enables consumers to choose, and it can be effective in altering corporate behavior. In the United States, industry was required to disclose the nature and amount of emissions, even legal ones. U.S. environmentalist Jeffrey Leonard believes that this requirement has done more than any other regulation to clean up industry.[3] It allows the public to see the records and act accordingly; it ranks companies, and it demonstrates waste to boards of directors.

Advantages of Economic Instruments

Environmental policy aims to protect the environment by altering and developing technology toward less polluting and less resource-intensive technology, by changing management behavior, by adjusting the structure of industrial output toward more efficiency and less pollution, and by changing consumer preferences. To achieve this, business wants an optimal mix of command and control, self-regulation, and economic instruments, and we believe that the present mix in most countries relies too heavily on the command approach. It is thus entirely appropriate that many governments are now studying and introducing economic instruments, which have two important advantages.

First, firms' compliance costs tend to be lower with economic instruments. The government's administrative cost may be lower as well. In air pollution, the cost of direct control is often from 2 to 20 times more expensive than the use of economic instruments.[4] This is because the

command-and-control approach does not encourage companies that can clean up at low cost to clean up more than companies for which similar steps are very expensive.

Second, economic instruments encourage innovation. They encourage polluters to change to cleaner technologies and to develop new technologies because it pays for them to clean up more, in particular if pollution rights are tradable. They encourage new entrants to try to gain a competitive edge by starting off with new technology. Command approaches can have the same effect, but as they often require companies to use a specific technology, they may not be as effective in motivating continuous change and improvement. In fact, regulations based on outmoded technologies can actually have the effect of slowing improvement in an industrial sector.

Neither the command nor the economic instruments approach should affect competitiveness within a nation for reasons other than environmental efficiency. As compliance costs are usually lower with economic instruments, their use in one country may make an industry there more competitive than the same industry in a country relying on regulations to achieve the same effect.

The command approach often seems more convenient because both business and governments have much more experience with regulation, and relatively little with economic instruments. So both may feel comfortable dealing with commands. Governments tend to favor a command approach because of this tradition and because they feel that regulation is more certain. Business has favored regulation in the past because it also is more familiar with this approach, and feels it can influence it through negotiation. In addition, in many nations regulations are passed but rarely enforced.

Business also fears that instruments might simply be added on to regulations in place, and that it will thus face a double burden. This should not happen. If a regulation is working, there is no need for an economic instrument. But there may be cases, under an optimal mix approach, where a regulation is used to guarantee health and safety standards and an economic instrument encourages continuous improvement.

A 1991 public policy study sponsored by U.S. Senators Timothy Wirth and John Heinz concluded: "Over the past two years, we have witnessed dramatic changes in the political landscape of environmental policy.

Legislators, bureaucrats, environmentalists, business persons, and citizens of all kinds have come to recognize that market-based instruments belong in our portfolio of environmental and natural resource policies."[5]

That same report introduced the concept of economic instruments as follows: "Why all this emphasis on market forces, in the first place? The answer is purely practical. Selective and careful use of economic incentives can enable us to achieve greater levels of environmental protection at lower overall cost to society. A central principle is that as consumers and as producers, each and every one of us needs to weigh the full social costs and consequences of our decisions before acting....Market-based environmental policy mechanisms provide various ways to make consumers and producers recognize these social costs and consequences, and thus provide incentives for environmental protection. The creativity and power of the market—the awesome strength of millions of decentralized decision-makers—can be deployed on behalf of environmental protection, instead of against it."[6]

The argument most often used by environmentalists against economic instruments, especially tradable pollution permits, is that they are "licenses to pollute." This argument carries no weight, for any command-and-control regulation that allows any pollution at all can also be described as a license to pollute.

Fair and Equal?

The use of economic instruments raises questions about the distribution of their impacts. If economic instruments have regressive effects—placing greater hardship on the poor than on the rich—then compensatory measures may be required. If a particular industry or sector is harder hit than others (for example, those that are highly energy-intensive), then transition measures to allow for the necessary changes may be required. Yet ultimately we have to accept that a move toward sustainable development will cause far-reaching change in the structures of business and industry; there will be losers and there will be winners.

Most of the current environmental taxes and charges on products in OECD countries are relatively small, on such items as shopping bags and batteries, which do not constitute a high proportion of any family's income. Thus they do not raise issues of distribution of effects.

But taxes on products that meet basic needs do raise such issues. A study by Britain's Institute of Fiscal Studies (IFS), for example, found that

the poorest British families spend a higher proportion of their income on energy than do wealthier families, so a charge on energy would hit them harder. Also, such a levy would provoke smaller reductions in energy use in richer households, which use more energy. But a tax could also produce returns that could be used to compensate groups that society wishes to protect.[7]

Since the idea is to change behavior, the best approach may be to charge the poor the same as the rich, but then redistribute money to the poor so they do not suffer unduly. They could receive credits or rebates. Many possibilities exist.

However, the IFS found that there were great differences between the efficiency of domestic energy use not only between but within classes. In other words, some poor households are more energy-efficient than other poor households, and the same is true of rich households. Thus the desire not to punish the poor must be balanced with the need to encourage changed behavior in all income ranges; large lump-sum compensations might decrease the incentive effect of a charge. Incentives can be provided by several methods, including schemes to use some of the charge to improve insulation in a house. Such schemes are best backed up by information and credit help. In the United States, some power companies offer to inspect every customer's home for energy efficiency, and to recommend improvements.

Experience So Far

A 1991 review of the prevalence of economic instruments in OECD countries found that their use is increasing rapidly.[8] Since a larger OECD survey in 1987, the number of charge systems either implemented or being contemplated increased almost threefold, and such systems were being used in 21 countries. There has also been a gradual shift away from using these instruments to raise revenues toward using them to change behavior.

Yet except for the Scandinavian countries, the use of such instruments—though growing—has remained limited. The OECD average was about six or seven instruments in use per country, with perhaps two or three water and waste user charges, a deposit refund system, and a tax differential on unleaded fuel being the standard spread.[9]

Economic instruments are used less in the developing world, probably because these countries have been struggling with issues of environmental management for a shorter time. Yet there is excellent work going on in the South that shows the scope for instruments there. At least three good reasons can be cited for developing countries feeling that they have much to gain from internalizing costs through economic instruments rather than regulations.

First, as noted, regulations are often more expensive. Southern environmental problems tend to involve resource use more than pollution, and these resource use problems tend to be spread across large rural areas rather than concentrated in cities, so the bureaucracy must be spread out as well. Thus economic instruments may be even more practical and cost-effective in the South than in the North. (Many developing countries, however, need to improve their institutional structure to make economic instruments work. And, needless to say, when large numbers of people do not participate in markets, as is the case with many of the rural poor, market instruments are not effective.)

Second, for developing countries reforming their tax structure, the potential revenue-raising side effects of most instruments may be helpful in decreasing direct and indirect taxes for the poor and taxes that discourage effort and investment.

Third, the South is in a position to study the North's long history of regulations and avoid the major errors. It is also in a position to monitor and copy—where appropriate—what works among the North's instruments.

But before new instruments can be put in place, two things should happen. Instruments already in place that actually encourage resource waste and environmental degradation should be removed. These include such things as tax breaks for clearing forests for farming, and subsidies on water, energy, pesticides, fertilizer, and so on. (Though in many developing countries, particularly in Africa, the problem is underuse, not overuse, of farm chemicals.) In many cases, the destructive subsidies are of most financial benefit to wealthier citizens who are able to use large amounts of subsidized water, energy, and chemicals, so removing them is "progressive." Any steps to do so, however, must be monitored carefully to see that the poor in developing countries are not made even worse off.

There are a number of basic preconditions for the effective operation of economic instruments. These vary from country to country but include such things as the establishment of firm property rights and

> *"Economic activity must account for the environmental costs of production. Environmental regulation has made a start here, albeit a small one. The market has not even begun to be mobilized to preserve the environment; as a consequence, an increasing amount of the 'wealth' we create is in a sense stolen from our children."*
>
> William D. Ruckelshaus
> Chairman of the Board
> Chief Executive Officer
> Browning-Ferris Industries

contract enforcement, liability laws, policy reform, and institutional reform. The best instruments for the South will be those that place the burden of proof of compliance on business, as governments tend to lack the institutions to do the job. These instruments will also be designed to gain the confidence of industry by encouraging rather than punishing.

A scheme for hazardous waste management in Thailand, proposed by the Thailand Development Research Institute, shows how economic instruments can be used for a problem thought in the North to be best controlled by command and control. Hazardous waste producers are charged by an Environment Fund a fee that would cover the transport, treatment, and disposal of the waste, plus the same amount again as an incentive to reduce wastes. Half the total charge goes to deal with the waste; the other half goes into an escrow account earning interest. The Fund determines how much waste an industry is likely to produce based on records in other countries. Once all the contracted waste has been delivered for treatment, the money and interest in escrow are returned to the waste generator. The escrow fund thus acts as a performance bond to ensure delivery of waste. As firms produce less waste, they pay less to the fund. Performance is monitored by private auditing firms.[10]

Economic instruments have long been used in the management of living resources, mostly in the forms of simple fishing or hunting licenses, which both provide revenue for the resource managing authority and usually set a catch or kill limit.

Modern sensing and communications equipment allows for such management approaches to be much more sensitive and sophisticated. New Zealand, for instance, manages the fisheries within its 200-mile Exclusive Economic Zone through the use of tradable permits to catch a certain quota of a given species of fish. A "paper chase," rather than inspectors, keeps track of catch amounts. Forms covering catches are filled in by skippers, permit owners, and processors, and then compared by computer. To base management more soundly on fish population dynamics, the quotas have been changed from tons of fish to percentage of allowed catch. Those fishing have generally welcomed the scheme—after hiring foreign scientists to check the accuracy of New Zealand government catch quotas.[11]

These examples of economic instruments within regulatory systems in the developing world and in the area of natural resources are only a small sample of the vast potential economic instruments have for protecting the environment.

The Right Mix

We need to ascertain where regulations work best and how they may be complemented by economic instruments and by self-regulation to form an optimal mix to achieve the objectives of sustainable development. The integration of command-and-control regulations and economic instruments is essential to avoid a two-tier, perhaps contradictory system. It would be highly inefficient, for example, to have one body imposing regulations and another setting charges in an uncoordinated manner.

We believe, and will be urging governments, that choices of mixtures of instruments, regulations, and self-regulation should be influenced by:

- *Efficiency:* The choices must be based on which measures work most effectively and most cost-effectively for society.
- *Flexibility of response:* Industry needs to be able to choose how to respond to regulation—that is, not whether to respond, but how to reach the target in the most efficient way.
- *Confidence in the regulatory environment:* Industry needs to know the nature and probable impact of regulation over significant periods of time so that it can plan its investments accordingly and not make technological investments that will be forfeited by rapidly changing regulations.
- *Gradual introduction:* Regulations should be introduced gradually so industry has time to plan its optimal response; if governments adopt the "precautionary principle," they will seek to introduce instruments quickly,

but will give industry compliance time. If governments do not act until damage is advanced, there will be no time for gradual introductions. For its part, industry must accept that where urgent remedy is required, urgent regulations and enforcement are also necessary.

• *A "level playing field":* Regulations should affect all comparable enterprises equally; while a level playing field can be established fairly easily under a single regulatory framework (such as national laws), countries at similar levels of economic development will need to harmonize their policies internationally to avoid trade distortions and unfair competition. The achievement of equity requires that different things be treated differently: a highly polluting industry will have to pay a higher pollution charge than a cleaner industry, but this inequality is the very purpose of the measure. Similarly, different levels of development between nations must lead to different standards and solutions in order to distribute burdens fairly and in proportion to the means available for corrective action.

• *Transparency of compliance:* It must be possible for each industry to be seen to comply with regulations; there must be no free riders or unduly privileged companies.

National Accounts

One way to support the internalization of environmental costs would be to alter the standard national accounts (SNAs) to reflect environmental damage and the depreciation of natural resources.

SNAs, upon which such indicators as gross national product (GNP) are based, were developed during World War II to allow governments to measure the effects of economic policies using standardized tools. GNP is a good instrument for many purposes and should be maintained, but it is faulty for measuring progress toward sustainable development. Not only does it offer no indication of environmental damage or the running down of natural resources, but the economic activity required to clean up pollution damage (such as oil spills) is paradoxically recorded as a contribution to economic welfare.

When a forest is felled for timber, GNP includes the income earned, but no loss of future productive capacity is recorded. If countries were run like businesses, there would be an accounting for depletion of valuable

assets such as forests, oil, topsoil, and water. A proportion of income from the flow of a capital stock such as oil would be invested to replace income from oil as it became exhausted. In the developing world in particular, rapid depletion of natural resources adds to the GNP and suggests economic success, but no allowance is made for the reduction of income that will follow when the resource is exhausted.

The Norwegian government in 1974 and the French government in 1978 both established systems of natural resource accounting and budgeting. In 1973, the Japanese government introduced a new measure of net national welfare (NNW), which adjusts national income for environmental and other factors. Records show that while Japanese GNP increased by a factor of 8.3 during 1955–1985, NNW increased by a factor of only 5.8.[12]

Some economists argue that the best way to improve SNAs is to subtract from GNP not only capital depreciation but three other figures as well: money spent repairing and protecting against environmental damage ("defensive expenditures"), a monetary equivalent for any residual degradation remaining after defensive expenditures (such as soil erosion and acid damage to buildings not repaired), and an allowance for depletion of natural capital such as forests. This would produce a "net national product" (NNP).

It would obviously be difficult to derive figures for some of the categories above, especially residual degradation. It would also be hard to quantify in monetary terms irreparable environmental damage such as the extinction of species. So other economists argue that such an NNP exercise is not at present feasible, and certainly not cost-effective.

But SNAs can still be dramatically improved by the addition of known environmental damages that can be estimated in monetary terms and by incorporating net changes in stocks of natural resources. The effects of such changes in national accounts calculation could be dramatic. They could mean that when annual economic indicators were announced by governments, they would include an indication of how much given industrial, forestry, or mining operations cost the nation in terms of real natural assets. It could be more effective than any other measure in ensuring that environmental concerns were taken seriously by key ministries, such as those responsible for finance, industry, energy, mining, agriculture, and forestry.

U.S. economist Robert Repetto and his colleagues showed that when depreciation for oil, timber, and topsoil were included in calculations of Indonesia's national economic performance, economic growth between 1971 and 1984 was not 7 percent—the official figure—but only 4 percent.[13]

British economist David Pearce and Swedish economist Karl-Göran Mäler have predicted relatively rapid change in ways by which nations judge their performance: "The system of national accounts can be seen as a statistical system monitoring the conventional economic areas. The work under way in many international organisations—United Nations, UNEP and the World Bank—and in many countries will probably, in a couple of years, extend this monitoring system to include environmental resources, both in order to provide a better statistical data base for economic analysis but also to yield an improved wellbeing performance index for nations."[14]

Society's Choice

Recent history has reemphasized the advantages of the market system over other economic systems. The market finds the most efficient methods for creating wealth, and it offers the best chances for progress by unleashing human creativity. It offers society effective paths toward its goals; but society, through the political and legislative process, must set those goals.

So long as creating wealth ranked far above protecting nature as the major objective of society, markets guided economic actors such as consumers and producers toward maximizing wealth creation without concern for the resulting degradation of nature.

Today the world's nations—to different degrees and with different priorities—appear ready to base a reassessment of their long-term objectives on the realization that economic progress can only be achieved amid plentiful environmental resources and within healthy global ecosystems.

Changing course in accord with this new realization does not imply abandoning a system that has proved its merits. But it does mean that economic actors need the right signals to steer them toward the new objective. The nature of such signals should be as compatible as possible with the nature of the market system.

The fundamental signals guiding market decisions are prices reflecting the relative scarcity of goods based on supply and demand. With a given supply, increasing demand should result in rising prices. This basic mechanism has never been given a real chance to work for the environment. The use, exploitation, and degradation of nature has not created signals of scarcity because those who "own" nature and its services—society, expressing its wishes and intentions through government—have tended to give away environmental resources and services for free.

When severe problems and imminent threats finally required action, governments chose to guide behavior through command-and-control regulations rather than through price signals. This approach works against, rather than with, the market and weakens its main advantages: wealth creation, efficiency, and innovation. Thus business acts in its own interests in calling for prices increasingly to recognize and reflect ecological realities.

It will be a long and complex task to make prices reflect the ecological impact of resource use and the production of goods and services. This task is also laden with difficulties: assessing values and determining unknown costs associated with ecological impacts; changing basic elements of existing industrial structures; introducing potentially distorting elements in international trade, which may put a higher burden on the poor; and tempting governments to abuse a potentially important source of revenue, by using it for purposes other than guiding choices toward sustainable development.

In view of these problems, we appeal for a long-term orientation, for calculable and internationally harmonized policies, and for the gradual introduction of appropriate market signals.

Approaches not based on market solutions may present even greater hazards. The advantage of the market approach is that risks are offset by new opportunities inherent in competition, efficiency, and innovation. If these essential strengths of human ingenuity are not made to work toward the new objectives of society, we see little chance of development ever becoming sustainable.

Environmental Economics: An Overview

Professor Tom Dean

Fundamental Questions

- Why do we have waste and environmental degradation?
- Why do we have "pollution" in a capitalistic economy?
- What is the role of environmental regulations?
- What are the best types of regulations for controlling pollution?
- Are we killing enough people on airplanes?

Market system and value creation

The Invisible Hand

- "...and by directing industry in such a manner as its produce may be of greatest value, he intends only his own gain and he is in this, as in many other cases, lead by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for society that it was no part of it. By pursuing his own interest he frequently promotes that of society more effectually than when he really intends to promote it."

  Adam Smith, The Wealth of Nations

Environmental and Natural Resources in Economics

Market failure

- Marginal social benefits and costs versus marginal private benefits and costs
  - The ideal system would include all costs and benefits in the market
  - Market may not be able to efficiently allocate goods & services
- Types of Market Failure
  - Imperfect competition
  - Imperfect information
  - Inappropriate government intervention
  - Public goods
  - Externalities

Inappropriate government intervention and Public Goods

- Inappropriate government intervention
  - i.e. Subsidies for resource extraction
- Public Goods
  - Characteristics of pure public goods
    - non-rivalry (one's consumption does not diminish the amount available to others)
    - non-excludability (persons cannot be excluded from consuming it)
  - Potential suppliers will not be motivated to produce goods for which they cannot exclude non-payers

Externalities

- Economic relationship which is not transmitted through a market
- Can be detrimental or beneficial to affected party
- Externalities make the economy non-efficient
  - Creates disparity between marginal social costs or benefits and marginal private costs or benefits
- Externalities increase the production of certain goods and encourage the production of pollution

National Accounts

- Gross National Product does not include:
  - Environmental Damage
  - The degradation of natural resources
- Paradoxically, the costs of cleanup are included as a contribution to economic growth
- A broader measure of economic growth and viability is vital to sustainable development!

Inter-temporal Equity and Discounting

- How much should we leave for future generations?
- The "tyranny of compounding"
- Should market interest rates be applied to benefits accruing from environmental resources?

Correcting for Market Failures through Government Policy

- Some argue that it is not necessary; Coase Theorem
- Four classes of government intervention
  - Moral suasion and self-regulation
  - Government production of environmental quality
  - Command and Control Regulations
  - Economic Incentives
    - Pollution taxes, subsidies, marketable pollution permits, deposit-refund systems

Optimal Level of Pollution

- Pollution Prevention Costs
- Pollution Damage Costs
- At some point it is no longer efficient to reduce pollution further
- Measuring Pollution Damage Costs
  - Must estimate the health impacts of pollutants
  - Must place a value on human life

Conclusions

- The market system is imperfect
- Imperfections result in excessive pollutant emissions and wasteful utilization of environmental and natural resources
- National accounting systems do not accurately reflect the total value created for society.
- Compounding greatly diminishes the present value of future benefits.
- Various methods exist to mitigate market imperfections
- An optimal level of pollution exists, and it is not usually zero

Conclusions

- "Bureaucratic socialism collapsed because it did not allow prices to tell the economic truth. Market economy may ruin the environment and ultimately itself if prices are not allowed to tell the ecological truth."

  Ernst VonWeizacker, Institute for Climate Environment, and Energy
- "The corner stone of sustainable development is a system of open, competitive markets in which prices are made to reflect the costs of environmental as well as other resources."

  Stephan Schmidheiny
- Do markets fail or do we fail to allow markets?

Intl Public Policy
Source Book: U2, Education
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Ed. Frederic Bolotin
Greenwood Publishers
1990

16

United States

David J. Webber

Although there were environmental protection programs adopted in the United States before 1970, mainly at the state and local level, environmental protection as a policy area came of age in 1970 with the passage of the National Environmental Policy Act, the adoption of the Clean Air Act and the Federal Water Pollution Control Act, and the establishment of the Environmental Protection Agency (EPA) as a quasi-independent agency. Much of the federal environmental legislation has been adopted in a period of strong public support for environmental protection and for basic support of governmental regulation. This golden era of environmental policy came to a quick halt because of the election of Ronald Reagan, with the resulting appointments of Anne Gorsuch and James Watt and a loss of public confidence in governmental regulation. Crandall and Portney (1984:47) placed these Reagan administration changes in context: "This country's efforts at environmental protection were encountering very serious problems well before President Reagan's initial appointees to EPA began adding to them. However, although these inherited difficulties presented certain problems to the fledgling administration, they also represented an opportunity to reshape environmental protection in a simpler, more effective, and less expensive form—an opportunity that has largely been lost."

Generally, the consensus among environmental advocates suggests that environmental quality has improved during the past decade. For example, The Conservation Foundation reports that the United States has made significant progress in areas in which laws and institutions have been explicitly devised to address specific problems like air and water pollution and wildlife protection (The Conservation Foundation, 1984:1).

Serious environmental problems, however, still exist: acid rain threatens to damage more than one region of the country; toxic-waste dumps present a potential health problem to many communities; water contamination and shortages are not uncommon across the 50 states; and soil erosion from mining and farming persists. Aside from these issues, environmental policies have been criticized for being ineffective, for contributing to inflation and poor industrial productivity, and for being an unjustified intrusion into private concerns and local or state governmental activity. Environmental policy is currently in a period of reconsideration. Among the major policy questions under reconsideration are the following: What should be the responsibility of each level of government in protecting the environment? What is the optimal level of environmental protection? Can more efficient and effective regulatory schemes be devised?

HISTORICAL OVERVIEW

The two earliest comprehensive federal initiatives were the Federal Water Pollution Control Act of 1948 and the Air Pollution Control Act of 1955. Before these federal efforts, environmental protection in the United States was limited to local ordinances and state laws primarily protecting drinking water. The first state to adopt air-pollution regulations was Oregon in 1952. Both of these federally adopted statutes initiated a gradual process of increased federal direction of air- and water-pollution control. Although both of these original acts limited the federal role to goal setter and technical advisor, subsequent amendments throughout the 1950s and 1960s, culminating in major amendments in the Clean Air Act of 1970 and the Federal Water Pollution Control Act (now called the Clean Water Act) in 1972, substantially increased the federal role. The Clean Air Act of 1970 required the EPA to issue health-based national ambient air-quality standards for seven pollutants and to establish a timetable for states to complete implementation. The federal role in air-quality regulation was strengthened by Congress authorizing the EPA to assume responsibility if a state fails to take appropriate and effective action. Similarly, the Federal Water Pollution Control Act of 1972 established national standards of effluent limits and set administrative and implementation timetables toward making major waterways fishable and swimmable by 1982.

Environmental regulation differs substantially from other types of social and economic regulation. Perhaps this is because environmental regulation is a relatively new area of governmental activity in which, presumably, it would benefit from the lessons learned in earlier regulatory efforts. Alternatively, the magnitude and complexity of environmental problems may explain the differences in regulatory approach. Among these differences are the importance of federal-state coordination, reliance on scientific information, and the opportunity for replacing traditional "command and control" regulation with more innovative approaches.

Due to the historical precedent of the states' regulating land use and human health and to the variation of environmental problems across the 50 states,

environmental regulation is marked by a considerable degree of shared federal-state regulatory authority. This intergovernmental approach demands a large dose of cooperation and coordination usually taking the form of federal standard setting accompanied by state implementation and enforcement. Generally, federal statutes adopt performance standards or emission levels, and states are granted the responsibility to select and design procedures required to meet the statutory guidelines.

The complexity of this web of intergovernmental relationships is demonstrated by the Clean Air Act. The principal framework of the Clean Air Act is the establishment of "national ambient air quality standards" (NAAQS) "to protect the public health and welfare," as well as "national emission standards" for certain hazardous air pollutants. These standards are set by the EPA, and each state is required to submit a State Implementation Plan (SIP) showing how the standards will be implemented and enforced in that state. Therefore, a uniform national air-quality standard is adopted, but individual states have discretion in regulating their own emissions to achieve that standard. The Clean Air Act is an ambitious statute that has been the topic of discussion because of its administrative complexity. For example, Crandall (1983:8) described the act as follows:

> The Clean Air Act Amendments of 1970 created a curious variety of federalism. State governments set individual standards for existing polluters, but the federal government dictates the goals. New-source standards are issued by the EPA, but offsets of emissions from older sources against emissions from new sources are administered by the states. Most enforcement responsibilities reside with the states, but the federal government retains civil penalty powers for punishing violators. The EPA can declare an air quality control region in nonattainment for one or more pollutants, but it can force compliance only through indirect incentives such as withholding of federal grant monies.

The Clean Air Act has not been effective in dealing with the sulfur dioxide causes of acid rain because its entire framework is focused on the emissions from sources as measured at a nearby monitoring station. Sulfur dioxide emitted high in the atmosphere, therefore, will most likely satisfy the provisions of the state implementation plan as required by the Clean Air Act but will be deposited in another area up to several hundred miles away. The construction of "tall stacks" has been a natural consequence of this localized monitoring and state control of emissions. Although there are several interstate provisions of the Clean Air Act, the act was not designed with complex problems like the transboundary transfer of pollutants in mind.

Although there has been a parallel development of federal water and air regulation, there are two major differences. First, in setting ambient air-quality standards, the EPA is instructed to consider only human health factors; in setting water standards, the EPA needs to consider technological and economic feasibility. Therefore, air-pollution control has been more health protective than the cost-conscious water-pollution regulations. Second, administrative responsibility

differs between the two types of pollution protection. National ambient air-quality standards are established by the EPA and implemented by the states, while water quality standards are initially set by state pollution control boards subject to EPA review (Durant, 1985:25–26.

The National Environmental Policy Act (NEPA) of 1969, which declared that the federal government "should use all practicable means . . . to create and maintain conditions in which man and nature can exist in productive harmony," required federal government agencies to prepare environmental impact statements for all "proposals for legislation and other major federal actions significantly affecting the quality of the human environment." Since its adoption on January 1, 1970, NEPA has resulted in more than 22,000 draft, final, and supplemental environmental impact statements and has been the subject of over 1,800 lawsuits (*Environmental Reporter*, 1985:3).

The adoption of NEPA, often hailed as the beginning of the environmental decade, demonstrates the great difficulty faced by Congress in comprehensively and systematically formulating environmental legislation. Because of the opportunity for judicial review of environmental impact statements, NEPA became a major tool of environmental interests in blocking federal action believed to be environmentally harmful. Yet NEPA was not a controversial piece of legislation; it did not even receive enough attention to warrant a roll call vote, and judicial review of environmental impact statements, which has become one of the most significant aspects of the act, was never discussed during congressional considerations (Liroff, 1976).

A major institutional development in the evolution of United States environmental policy was the establishment of the Environmental Protection Agency (EPA) in December 1970. By intent and design, the EPA is drastically different from other regulatory agencies, in part, because it was established in light of the lessons learned from the experienced agencies. Ackerman and Hassler (1981) distinguished the EPA from the New Deal agencies by pointing to several differences: single administrator versus multimember commission, policy based rather than industry or problem based, and having responsibility for narrow, although ambitious, objectives with specific legislative authorization rather than general goals. The EPA initially was organized by clustering together no less than 10 agencies that previously had been dispersed throughout the Departments of Health, Education, and Welfare; Interior; and Agriculture and the Atomic Energy Commission (Marcus, 1980). The EPA has been given general authority to administer each of the following: Clean Air Act; Clean Water Act; Resource Conservation and Recovery Act; Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); Safe Drinking Water Act; Toxic Substances Control Act; and the Federal Insecticide, Fungicide, and Rodenticide Act.

The Reagan administration has been very effective in reducing both the EPA's budget and its personnel. Between 1981 and 1984 the budget for the EPA's four major operating areas (water, air, hazardous wastes, and toxic substances) decreased from $968 million to $474 million—a decline of 44 percent. Similarly, the number of employees decreased from 5,977 in 1981 to 4,246 in 1984 - a decline of 27 percent. Water-quality programs received the largest cuts (Crandall and Portney, 1984:66 67). These reductions are consistent with the Reagan administration's dual goals of reducing federal spending and eliminating regulatory activity.

Americans continually have supported environmental protection, although opposition to environmental regulation did reach its high point about the time of the 1980 presidential election. In numerous opinion surveys since 1973, there has been a fairly consistent finding. About a third of the respondents have said that environmental laws "have struck about the right balance," slightly fewer than a third have said that "they have not gone far enough," and about 22 percent have thought that they "have gone too far" (Ladd, 1982). Despite widespread and persistent public support for the protection of the environment (see Mitchell, 1984), the American people have accepted the reduction in environmental regulatory activity at least partially because of the widespread perception that governmental intervention into the American economic system is harmful. For example, although 70 percent believe that "governmental intervention into the economic system usually causes more harm than good" and 52 percent believe that "generally limited government is best," 72 percent of the respondents believe that "American values and beliefs are partially to blame for environmental destruction," and 79 percent think that "endangered species should be protected even if it means sacrificing some things for ourselves" (*Bloomgarden*, 1983). This tension between supporting environmental protection and opposing an active role of government in the economic system results in a cautious, uncertain citizenry and a public policy agenda that includes both a concern for environmental problems like acid rain and hazardous wastes and support for Reagan administration initiatives to reduce governmental regulation.

A national survey conducted by Louis Harris (1983) for *Business Week* found that any weakening of public support for environmental protection that might have occurred at the time of the election of Ronald Reagan has been dramatically reversed. Harris found: (1) support for a stricter Clean Air Act had risen from 29 percent in 1981 to 47 percent, (2) support for a more stringent Clean Water Act had increased from 52 percent in 1981 to 61 percent, (3) by a margin of 78 percent to 17 percent respondents saw no reason for granting an exception to the Clean Air Act in the name of economic security and growth, (4) support for reducing auto-emission standards declined from 38 percent in 1981 to 26 percent, and (5) support for relaxing air standards so that power plants can burn more high-sulfur oil and coal declined from 29 in 1981 to 19 percent.

These studies of public opinion about environmental problems and policy indicate that although Americans generally are concerned and supportive of efforts to clean up the environment, they also are concerned about the adverse consequences of governmental intervention. In the long run, continued support for environmental protection very well may hinge on the public's perception of

the relative effectiveness of governmental efforts to protect environmental quality.

Historically, environmental policy largely has been ignored by presidents and left to congressional direction and leadership. Although President Reagan has had a large impact on environmental policy by virtue of his budget cuts and appointments, and President Nixon played an important role in the beginning of the "environmental decade" of the 1970s, most of the major legislation was a result of policy entrepreneurs in the Congress. Environmental legislation tended to be developed through bipartisan coalitions in congressional committees that sought consensus on the major issues (Vig and Kraft, 1984).

Two other factors deserve brief mention as significant political influences shaping environmental policy. First, triggering mechanisms—relatively intense, pivotal events—have played a large part in focusing public attention on environmental problems. Triggering mechanisms like the ecological disasters of the Santa Barbara oil spill in the 1960s and Love Canal in the 1970s, political events such as Earth Day, 1970, and the anti-nuclear demonstrations of the late 1970s, and the publication of books like Rachael Carson's *Silent Spring* (1962), Esposito's *Vanishing Air* (1970), and Zwick and Benstock's *Water Wasteland* (1971) all have contributed to keeping the environment on the public's mind and on the political agenda.

A second factor is the existence and growth of several environmental organizations that have become powerful, permanent actors in the environmental policy process. Among them are the Sierra Club, Audubon Society, National Wildlife Federation, Izaak Walton League, Friends of the Earth, and the Environmental Defense Fund. Although these groups differ in purpose, constituency, and resources, jointly they have provided direction and organizational support for influencing environmental policy.

Political participation in environmental policy-making best can be understood through the use of economists' notions of market failure and public goods. Economists often view the environment as a commodity or factor of economic production whose value is reflected in political and economic decisions. Viewing environmental resources as a factor of production offers several implications for making environmental policy. The very nature of the environment conforms with the economist's notion of a public good—one person's use and consumption of the environment does not substantially affect the personal welfare of others. This context creates the conditions necessary for a "tragedy of the commons" (see Hardin, 1968) whereby unconstrained freedom brings ruin to all. Since we all are exposed to the same level of environmental quality regardless of our individual effort to protect the environment we all have incentives to become "free riders." Because the benefits of protecting and improving environmental quality are widely diffused, individual citizens have little incentive to participate in obtaining environmental protection. The cost of compliance with environmental regulation, however, falls directly on polluters. Any savings from procuring reduced regulation or non-compliance directly increases the profits of the producer. Incentives to participate in the environmental regulatory process, therefore, are not balanced. A good example of the uneven incentives to participate in the environmental policy process is offered by Bruce Ackerman and William Hassler (1981), who discussed in some detail how mandatory scrubbing of coal-fired electricity generators came about because of the intense lobbying of eastern coal interests without the consideration of national interests.

A second implication of the economist's view of environmental quality is that efforts to promote environmental quality normally should seek to "internalize externalities," that is, force polluters to include the social or external cost of pollution into the price of a good or service. Economic incentive-based regulation, discussed below, is intended to achieve this internalization of externalities more efficiently (less costly) than traditional regulation.

Finally, the costs and benefits of environmental regulations are important economic considerations in evaluating the success of regulatory efforts. Although environmental regulation has been harshly criticized in the Reagan administration, there is mixed evidence about its economic impact. As will be discussed below, such an economic evaluation is difficult because it is easier to identify and estimate the economic factors associated with the costs of regulation than it is to calculate the costs of environmental pollution.

Environmental protection necessitates a reconciliation of fundamental attitudes toward nature, technology, economic growth, and social values (Barbour, 1980). To the extent that environmental protection reduces economic growth or alters existing lifestyles, it will constantly generate opposition in societies that promote these alternative values. Environmental regulation in the United States creates a fundamental tension between competing American values: unregulated capitalism, and environmental concern. Although the wealth of natural resources permitted earlier generations of Americans to adopt a frontier attitude, moving on to newer, uncontaminated land and water, the conservation movement at the turn of the century resulted in the creation of national forests, parks, and wildlife reservations. Given three types of alternative environmental attitudes (biocentric, ecologic, and economic; see Petulla, 1980:27–39), environmental protection in the United States historically has been motivated by an economic conservation perspective. Conservation efforts resulting in national forests and parks were motivated not by the belief that non-human organisms should be protected from human induced ecological damage (as suggested by the ecological and biocentric views). Instead, such conservation was predicated on the belief that the long-term economic interests of society required conserving, replenishing, and cultivating the natural environment. This perspective, while promoting environmental quality, implies that environmental protection is just one of many social values and that trade-offs among these values are necessary.

CURRENT STRATEGIES OF POLICY INTERVENTION

The National Environmental Policy Act of 1969 (NEPA) set the tenor for much of the environmental regulation adopted during the 1970s. The NEPA

Figure 16.1
Major Federal Environmental Statutes

I. Procedure

National Environmental Policy Act (1969)

Environmental Quality Improvement Act (1970)

II. Environmental Destruction

A. Medium-based

Clean Air Act Amendments (1977)

Federal Water Pollution Control Act Amds (1977)

Safe Drinking Water Act (1974)

Noise Control Act (1972)

B. Industry-based

Aircraft Noise Abatement Act (1968)

Water Quality Improvement Act (1970)

Motor Vehicle Air Pollution Control Act (1965)

Federal Environmental Pesticide Control Act (1972)

Federal Insecticide, Fungicide, and Rodenticide Act (1972)

Surface Mining Control and Reclamation Act (1977)

Occupational Safety and Health Act (1970)

Toxic Substances Control Act (1977)

Comprehensive Environmental Response, Compensation, and Liability Act (1980)

Nuclear Waste Policy Act (1983)

III. Resource Depletion

Marine Mammal Protection Act (1972)

Figure 16.1 (continued)

Endangered Species Act (1973)

Resources Conservation and Recovery Act (1976)

IV. Resource Management

Coastal Zone Management Act (1972)

Federal Land Policy and Management Act (1976)

National Forest Management Act (1976)

called for federal policy designed "to attract the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences" and "to achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities." United States environmental policy has been very ambitious: the Clean Air Act requires a reduction in seven pollutants to protect human health with an adequate margin of safety, the Federal Water Pollution Control Act aimed to make all navigable waters "fishable, swimmable" by 1982 and free of additional discharge by 1985, and the Surface Mining Control and Reclamation Act set high standards for reclamation including returning mined land to its original contour (Webber and Webber, 1985).

There are about 32 major federal statutes comprising federal environmental policy (Advisory Commission of Intergovernmental Regulations, 1981:32–33). If environmental policy is defined more broadly to include natural resource management and conservation, the number of congressionally enacted laws easily exceeds 100 (for a comprehensive listing of such acts from 1789 to 1976 see Beard, 1978). Wenner (1982:16–18) identified 52 laws subjected to environmental litigation during the 1970s. Figure 16.1 lists the major federal statutes that define United States environmental policy.

A compilation of environmental statutes would be much larger if all statutes relating to a specific environmental problem were included. For example, Lester (1983) listed 29 federal statutes affecting toxic substance and hazardous waste control. They include major statutes like the Toxic Substance Control Act of 1976 and the Clean Air Act but also specific legislation pertaining to the transportation of toxic substances by rail and water, the use of lead paint, and consumer product safety.

Environmental regulation makes heavy demands on society's scientific, administrative, and technical knowledge and capacity. The dominant approach has been for Congress to adopt specific environmental standards without clear knowledge of the scientific, technical, and administrative constraints of an issue. Under the Clean Air Act, for example, Congress directed the EPA to establish national

ambient air-quality standards (NAAQS) that provide an "adequate margin of safety" against adverse health effects. This approach implies that there is some "threshold" pollution level below which no human health is threatened. Setting the NAAQSs has become a search for this threshold despite the belief of many epidemiologists that a perfectly safe threshold for society does not exist. Some individuals are so sensitive to pollution that any concentration causes adverse health effects. A strict interpretation and enforcement of the Clean Air Act would mean that pollution levels would be set at zero (Crandall and Portney, 1984:52). In addition to not being what Congress probably intended, such strict interpretation would shut down the American economy. Clearly, the basic standard-setting approach requires reconsideration.

Because environmental regulation necessarily requires altering traditional economic production processes, private industry is naturally less than fully enthusiastic about the adoption and implementation of environmental regulation. While part of this opposition may be broadly ideological (see Milbrath, 1984), the private sector's opposition more likely stems from the direct impact of environmental regulation on businesses. Almost all environmental regulation results in higher production costs, more involvement with engineers and lawyers, time delays, and new production techniques. For example, most air and water policy is "technology forcing" that requires parties in the private sector to undertake research and development programs at their expense. A widespread response of the business sector was to challenge environmental regulations in the judicial process. Although this response may have resulted in immediate savings to industry it was usually only of temporary benefit since it delayed administrative action rather than prevented it.

Lester Thurow has argued that the policy stalemate must end if the American economy is to be revitalized. He believes:

> Unless we are to be permanently bogged down in fighting about the environment, goods and services simply have to be produced in ways that do not result in environmental deterioration. This means more expensive goods and services. Utility executives may not like stack scrubbers, but it is more important to get coal-fired power plants built than to argue about stack scrubbers. . . . Environmentalism is the wave of the future. As such, it makes more sense for those who are interested in economic growth to reach an accommodation with it than to try to resist it (1980:192).

GENERAL EVALUATION

The total cost of environmental regulation includes both the direct costs of operating regulatory agencies like the EPA and the compliance costs borne by polluters. Because of the federal budget process it is much easier to evaluate the direct regulatory costs than it is to estimate compliance costs. The Reagan administration has reduced the EPA budget from $968 million in 1980 to $474 million in 1984 (Crandall and Portney, 1984:68). The total cost (i.e., regulatory

costs and compliance costs) of pollution control is much higher, however, and was estimated by the Bureau of Economic Analysis to be $62.7 billion in 1983 with $29.1 billion expended for air-quality programs, $23.5 billion for water-pollution control, and $10.3 billion for solid-waste cleanup (Rutledge, 1985:20). These pollution-abatement costs comprise about 2 percent of the United States gross national product. According to the Council on Environmental Quality (CEQ), pollution-control cost per citizen in the United States was $47 in 1974 and $184 in 1977. The CEQ estimated that compliance with the Clean Air Act cost $22 billion in 1979 and expects it to increase 38 percent by 1988 (Marcus, 1986:159).

Environmental protection regulations have been criticized for contributing to the economic stagflation that hampered the United States throughout the 1970s. One study found, however, that between 12 and 25 percent of the decline in productivity growth in the private sector is attributable to *all* federal regulation, with environmental regulation being only a portion of that decline (Haveman and Christiansen, 1981). Rose (1983), however, reviewed several econometric studies of the macro-economic impact of air- and water-pollution abatement and reported that the most prominent studies find a rather small impact. These studies find the impact to be in a range of a 1.6 percent increase to a 2.0 percent decrease in gross national product with a yearly average of a 0.3 percent reduction. Similarly, studies of the contribution of pollution-abatements costs to the inflation rate suggest an impact of between 0.2 and 0.6 of a 1.0 percent increase in prices (Portney, 1981). Moreover, Portney observed that in addition to affecting price levels and productivity, environmental regulation also influences decisions of whether to undertake specific economic activities. This indirect cost is virtually impossible to measure.

It has proven difficult to assess accurately the effectiveness of federal environmental policy for several reasons. First, monitoring data are generally incomplete and unreliable. Second, when a change in environmental quality is observed, often factors other than regulation, such as macro-economic fluctuations, price changes, or new production processes may be primarily responsible. Third, regulatory programs can be effective even if there is no improvement in the environment because they prevented deterioration of the environment in a growing economy. For example, U.S. industrial production increased by about 36 percent between 1970 and 1980, and the number of cars and vehicle miles traveled increased by more than 50 percent. The improvement in air quality and the stability in water quality suggests that air- and water-quality programs were successful (Crandall and Portney, 1984:55).

Generally, evaluations of both air and water quality show that improvement has occurred during the past decade. Between 1970 and 1982, for example, total national sulfur dioxide emissions declined by about 25 percent, particulate emissions by 58 percent, and carbon monoxide by 27 percent (Council on Environmental Quality, 1983:3). Viewed from another perspective, people are exposed to less hazardous air as indicated by a CEQ analysis that found that between

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1974 and 1978 the number of unhealthful days declined by 18 percent in a sample of 23 metropolitan areas. "Hazardous" days, the most threatening category, dropped by 55 percent (Council on Environmental Quality, 1980). Likewise, biological oxygen demand (a measure of organic pollutants) in water has declined by 71 percent, suspended solids by 80 percent, oil and grease by 71 percent, dissolved solids by 52 percent, phosphates by 74 percent, and heavy metals by 78 percent (Council on Environment Quality, 1980). Not withstanding these major improvements in the quality of the environment, it is not entirely clear that the threat to human health has been reduced. For example, the Clean Water Act has resulted in less dissolved oxygen (a measure of amount of organic waste) contained in water, but it has done little to reduce bacteria, nutrients, sediment, and toxic substances that pose a much greater threat (Ingram and Mann, 1984).

Freeman (1982) estimated the benefits and costs of air- and water-pollution-control programs and found that regulation of stationary sources of air pollution offers positive benefits whereas mobile source regulation and water-pollution-control programs are not cost effective. Stationary sources, for example coal-fired generators or industrial smelters, are centralized sources that can be individually designed and retrofitted for emission regulation, but mobile sources, usually motor vehicles, have proven more difficult and costly to regulate due to their number and variety. Specifically, for 1978 Freeman calculated estimated benefits of controlling stationary sources to be between $4.8 billion and $49.4 billion with a most likely point estimate of $21.4 billion. Compared with the CEQ cost estimate of $9.0 billion for stationary source regulation, these control programs are economically worthwhile (Freeman, 1982). On the other hand, the benefits of mobile source regulations are estimated to be between $0.1 and $1.7 billion with a most likely point estimate of $0.3 billion. Compared with the CEQ's cost estimate of $7.6 billion, mobile source abatement programs do not have a favorable benefit-cost ratio. Similarly, Freeman (1982) estimated the benefits of water-pollution control to be between $3.8 billion and $18.4 billion with a most likely point estimate of $9.4 billion. Compared with the CEQ's cost estimate of $10.2 billion for 1978, water-pollution-control programs do not have net benefits. Similar conclusions are reached by Lave and Seskin (1977), who found that stationary source emission control results in a net benefit of $25 billion whereas motor-vehicle emission regulation shows a net loss of $6 billion.

Freeman (1982) pointed out that unfavorable benefit-cost ratios do not necessarily imply that environmental regulation should be eliminated but rather that program adjustments need to be considered that reduce compliance costs or alter the incentive structure for compliance. Environmental program goals may be appropriate, but programs can be poorly designed, resulting in excessively costly compliance.

IMPLICATIONS FOR THE ENVIRONMENT IN THE UNITED STATES

Environmental protection as delineated in congressional legislation and administrative regulation since 1970 must be considered a mild success. Much

progress has been made in improving air and water quality, but serious problems remain in curtailing toxic wastes, soil erosion, and other non-point source pollutants. Realizing that the EPA was structured to serve the conflicting and multiple objectives of Congress and the president and that the "EPA was not a single organism with a single will, but a series of different organisms with different wills" (Marcus, 1980:101), Marcus evaluated the EPA's performance harshly. He believes that the EPA did not live up to its expectations because "it neither achieved its statutory goals in the timetable prescribed by Congress nor pursued those goals with regard to the least cost to society as the White House intended. If rationality is defined as the achievement of expected outcomes and the accomplishment of intended goals, then EPA achieved neither the expected outcomes nor intended goals of the White House or Congress" (Marcus, 1980:163).

The most notorious example of the EPA's failure probably is hazardous-waste regulation. The Resource Conservation and Recovery Act (RCRA) of 1976 regulates the transport, storage, and disposal of hazardous waste by requiring states to establish "cradle to grave" tracking of those wastes. Cohen (1986:188) observed that "RCRA guidelines for state solid waste management plans were due within eighteen months; these guidelines were not issued until almost three years after the law had been passed." Similarly, implementation of hazardous-waste programs after regulations were adopted has been very troublesome. For example, only $8 million of $78 million appropriated by Congress for hazardous-waste cleanup was spent in 1981, and one-third of the first $180 million collected from fees paid by industry could not be accounted for by administrators (Marcus, 1986:159).

A major failure of environmental regulation is monitoring and enforcement. Although most environmental statutes require the EPA to monitor compliance with enacted legislation, the EPA does not have a centralized pollution-monitoring system and relies on state and local governments to collect data (Stanfield, 1985). Consequently, data are often incomplete and of dubious validity. In a 1979 study of the EPA's air-monitoring program, the General Accounting Office found "that 72 percent of the monitors were in the wrong place, 58 percent of the equipment was of the wrong kind and 81 percent of the sites had problems which could adversely affect the data's reliability" (Stanfield, 1985:644).

In part due to the lack of monitoring, non-compliance with existing regulations is considered to be widespread. For example, a General Accounting Office (1983) study of a random sample of municipal and industrial waste-water dischargers found that 82 percent exceeded their monthly average permit limits at least once during the 18-month study period and that 31 percent were in "serious non-compliance" meaning that they exceeded permit limits for one or more pollutants by 50 percent or more in at least four consecutive months. Inspection and enforcement are probably the most neglected aspects of environmental regulation.

A continuing debate surrounding environmental policy focuses on the appropriate level of government for making environmental policy decisions. A good example of conflicting local, state, and national interest, and the difficulties in deciding which level of government in a federal system is the appropriate

decision-making jurisdiction, relates to the storage of nuclear wastes. The Nuclear Waste Policy Act of 1983 requires the federal government to designate safe disposal facilities after an extensive period of state participation. If a state objects to having a site located within its borders, both the House and the Senate must approve the selection of the site (Tarlock, 1983). This policy decision puts national and state interests in conflict because although the nation needs nuclear-waste storage sites, no state is willing to house one.

The 1983 Annual Report of the Council on Environmental Quality identifies three "evolving issues" for environmental policy: toxic pollutants, demographic shifts to the Southwest causing greater demand for resources, and long-term, long-distance effects (p. 9). The CEQ lists several factors with which environmental policy in the 1980s should be concerned. These factors (flexibility, regulation of carcinogens, and risk assessment and management) pertain to the full spectrum of environmental regulation.

Flexibility of environmental regulation should be increased by relying more on economic-incentive-based regulation. This likely change in environmental policy during the next decade focuses on the design of regulatory schemes employed to achieve publicly desirable goals. During the past two decades a large literature has accumulated designing and proposing the use of economic incentives to encourage environmentally sound behavior (see Anderson et al., 1977; Baumol and Oates, 1979; Crandall, 1983 and Tietenberg, 1985). The logic underlying economic-based policy tools is simple: since prices allocate scarce privately owned resources, they can also be used to allocate scarce publicly owned resources. After ownership rights have been established, producers of externalities should be charged the value of any third party effects generated. Theoretically, a firm generating environmental damage should be billed the total social costs of that damage such that the social resources affected are paid for by the user. The tax, fee, charge, or levy, therefore, forces the producers of externalities to consider social costs in making production decisions.

Although the calculation of the value of social resources affected by a producer is very difficult in practice, the logic is clear: the price charged should cover the social cost of damage to the publicly owned resources. In simple cases of air and water pollution it is relatively easy to estimate the appropriate price, but in most realistic environmental problem situations such calculations are very complex. For example, plant emissions into air and watersheds can be monitored and measured accurately, and a per unit emission charge can be levied on the producer. The social costs of the discharge from the Reserve Mining Corporation in Minnesota into Lake Superior were estimated as stemming mainly from lake eutrophication, the increased need for water filtration, and the creation of a health hazard. Such social cost estimates, which can serve as the basis for an effluent charge-based regulation scheme are relatively easy to calculate because they focus on damages to a semi-closed system—Lake Superior. On the other hand, the appropriate fee to be charged a producer of hazardous waste is difficult to conceptualize and even more difficult to calculate (Webber, 1985). These market-

based incentives are promoted as an alternative to direct governmental regulation and are designed to be more efficient and administratively easier to implement than the traditional promulgation and inspection type of regulation. Recently, there appeared to be a rejuvenation of interest in market-based incentives as indicated by the Environmental Protection Agency's initiation of emission offset programs and the consideration of the bubble concept for regulating air emissions in a geographic region (Crandall, 1983; Tietenberg, 1985).

Another potential change in environmental regulation is the control of cross-media pollutants in a coordinated fashion instead of the present single medium (air, water, and soil) approach. In the regulation of agricultural chemicals, for example, an integrated approach would focus on the transformation of pesticides or fertilizers from soil to water (via runoff) and to air (via wind erosion and evaporation) and seek to prevent environmental damage by examining all stages of cross-media transfer. Environmental regulation, therefore, would have to consider: (1) the initial production and sources of pollution; (2) the effect of pollution controls; (3) the pollutant's physical, chemical, and biological transformations; and (4) the various ways human and environmental damage can occur (Conservation Foundation, 1984:321).

Finally, environmental regulation in the future must deal more effectively with long-term and less localized environmental problems. Acid rain and the rising carbon dioxide level in the atmosphere (the "greenhouse effect") are two good examples. Several proposals are currently being considered in Congress as it prepares to extend the Clean Air Act. These bills have a wide variety of approaches to achieve sulfur dioxide reduction and differ in the amount of sulfur dioxide emissions reduction prescribed, the way such rollbacks would be achieved, the way costs would be distributed, and the geographic areas included in a sulfur dioxide reduction plan (see Webber, 1985).

Similarly, the long-term consequences of an increase in carbon dioxide on the environment are not adequately addressed in present regulations. Both the EPA (1983) and the CEQ (1983) have addressed this issue and identified the extent of potential damage as well as alternative corrective proposals. The American political system, however, is better suited to considering immediate policy problems than to incorporating long-term considerations into public policy.

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Environmental Laws & Regulations 101

**** QUIZ ****

1. Which of the following activities might be subject to a federal or state environmental law or regulation if conducted at home? If conducted as a business practice or at the work place? Place an "X" in the appropriate column.

		Home	Work
a.	Throwing away a light bulb	_____	_____
b.	Changing car oil	_____	_____
c.	Cleaning a bicycle chain	_____	_____
d.	Purchasing real estate	_____	_____
e.	Filling up a car's gas tank	_____	_____
f.	Servicing an air conditioner	_____	_____
g.	Discarding old electrical equipment	_____	_____
f.	Building a pier or dock	_____	_____
g.	Burning leaves or trash	_____	_____
h.	Removing a flag pole	_____	_____

Many common business situations can be subject to the jurisdiction of one or more federal environmental laws. From the following list of laws, place the letter(s) of laws that may be applicable to the following business situations.

a. The Clean Air Act
b. The Clean Water Act
c. The Safe Drinking Water Act
d. The Toxic Substances Control Act
e. The Resource Conservation and Recovery Act
f. The Comprehensive Environmental Response, Compensation, and Liability Act
g. The Atomic Energy Act

2. A dentist establishes a new practice. _____

3. A landscape firm is asked to plant grass in a swampy area. Some fill material may be applied to the area. _____

4. An electronics store wishes to add a customer service shop that will repair and clean electrical equipment. _____

5. A trucking company that handles only freight expands into waste hauling. _____

6. A firm acquires a chain of gas stations. _____

7. Several investors buy an import/export firm. _____

8. A local utility firm decides to expand by adding four new coal-fired boiler units. _____

9. An asphalt firm gets a contract to pave a new parking lot for a large industrial firm. _____

10. A thrift store receives a shipment of "slightly damaged" coleman lanterns which had been fully assembled (including fuel) for a special christmas promotion. The store can sell about half of the lanterns, but must dispose of the rest. _____

Environmentalism Began in The 1970's

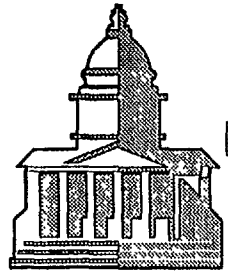
* 1970 - Clean Air Act (CAA)
* 1972 - Clean Water Act (CWA)
* 1974 - Safe Drinking Water Act (SDWA)
* 1976 - Resource Conservation & Recovery Act (RCRA)
* 1976 - Toxic Substances Control Act (TSCA)
* 1980 - Comprehensive Environmental Response, Compensation & Liability Act (CERCLA)
* 1984 - Hazardous & Solid Waste Amendments (HSWA)
* 1986 - Superfund Amendments & Reauthorization Act (SARA)

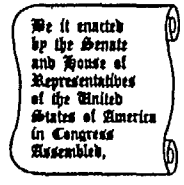
Some Gory Details About Environmental Regulations

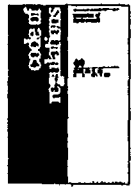
- Over 9,000 pages of federal rules and regulations govern environmental risks.
- $100 billion spent annually to comply with federal environmental laws and regulations.
- Three Sources of Requirements
  1. Legislation/Statutes
  2. Regulations promulgated by statutes
  3. Court decisions/Common law
- Federal, state, and local laws/regulations apply

  States and localities can apply more stringent standards
- Conflicts, overlaps, and complexities from level of regulation and different regulations and agencies (i.e. OSHA & EPA)
- Laws focus almost exclusively on command and control
- Laws don't recognize diminishing marginal benefits
- The CJO factor!

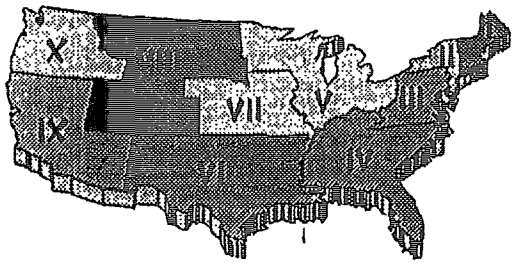
How Regulations Are Promulgated



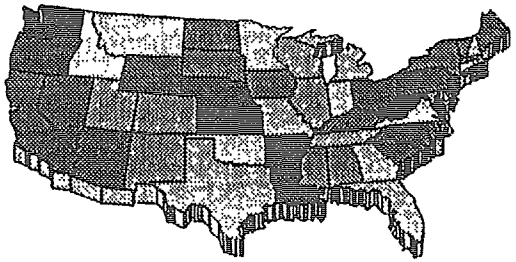




SOME REGULATORY PROGRAMS ARE GIVEN TO THE STATES, SOME NOT



CERCLA
TSCA



CAA, CWA,
SDWA, RCRA

The Clean Air Act

- Established National Ambient Air Quality Standards (NAAQS)
  - Ozone, SO_2, particulates, etc.
  - Areas in non-attainment of NAAQS heavily regulated
- Established hazardous air pollutants (HAPs)
  - Originally eight HAPs
- 1990 CAA Amendments greatly changed law
  - Now 189 HAPs
  - Acid rain
  - Ozone-depleting substances
  - Permits

THE CLEAN WATER ACT

- SECT. 402 NPDES PROGRAM REQUIRES PERMITS FOR DISCHARGES TO U.S. WATERS
- SECT. 404 REQUIRES PERMITS FOR DREDGING & FILLING
- SECT. 311 REQUIRES CLEAN UP OF HAZARDOUS SUBSTANCE & OIL SPILLS
- OIL POLLUTION ACT OF 1990 ADDED BIGGER FINES & PENALTIES (RESPONSE TO EXXON VALDEZ)

THE SAFE DRINKING WATER ACT

- SETS DRINKING WATER STANDARDS
  - USED BY OTHER LAWS FOR LEVELS THAT ARE PROTECTIVE OF HUMAN HEALTH
- UNDERGROUND INJECTION CONTROL (UIC) PROGRAM REGULATES INJECTION WELLS
  - "WELL" MEANS HOLE WHOSE DEPTH GREATER THAN LARGEST SURFACE DIMENSION
  - SDWA PHILOSOPHY IS BASIS FOR EPA'S GROUND WATER PROTECTION STRATEGY

THE RESOURCE CONSERVATION & RECOVERY ACT

- ASSURES CRADLE-TO-GRAVE MANAGEMENT OF HAZARDOUS WASTES
- PERMITS REQUIRED FOR FACILITIES THAT TREAT, STORE OR DISPOSE OF HAZARDOUS WASTES
- REGULATIONS VERY PRESCRIPTIVE
- LAND DISPOSAL OF HAZARDOUS WASTES WITHOUT TREATMENT IS BANNED
- RECYCLING OF HAZARDOUS WASTES CONTROLLED

THE TOXIC SUBSTANCES CONTROL ACT

- REGULATES CHEMICALS IN COMMERCE
- REQUIRES PRE-MANUFACTURE NOTICE/INFORMATION GATHERING
- CURRENTLY REGULATES ASBESTOS & PCBs AMONG OTHERS

THE COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION & LIABILITY ACT

- REPORTING & CLEANUP OF RELEASES OF "HAZARDOUS SUBSTANCES"
- STRICT/JOINT & SEVERAL LIABILITY
  - RESPONSIBLE PARTIES CLEAN UP AT OWN EXPENSE
  - SINGLE PARTY CAN PAY FOR ENTIRE COST OF CLEANUP
- SARA REQUIRES REPORTING RELEASES OF HAZARDOUS SUBSTANCES

National Environmental Policy Act

Established in 1970 to:

- Declare a national policy which encourages productive and enjoyable harmony between man and environment
- Promote efforts which prevent or eliminate damage to the environment
- Enrich the understanding of ecological systems
- Established the Council on Environmental Quality (CEQ) within the Office of the President

CEQ oversees individual agencies' NEPA compliance.

- Mandates environmental impact statements for all major federal projects

Other Important Federal Legislation

- Federal Insecticide, Fungicide, and Rodenticide Act
- Ocean Dumping Act
- Endangered Species Act
- Nuclear Waste Policy Act of 1982
- Surface Mining Control and Reclamation Act of 1977
- Oil Pollution Act of 1990
- Low-level Radioactive Waste Policy Act

February 15, 1998

Module I

Power Plant Energy and Environmental Issues

Power Plant Energy and Environmental Issues

1. Generating Capacity

   - Demand Growth in Developed and Developing Economies
   - Selection of New Plant Energy Source(s); interplay of availability, cost and environmental impacts
   - Siting of Plants (principally a nuclear plant concern)

2. Generating Plant Conversion Efficiency

   - User Demand-Side Management Programs

3. Power Plant Environmental Issues

   - Fossil Fuel Plants

     Concerns:
     - Global warming (CO_2 emissions)
     - Acid rain

     Recent Regulatory Action:
     - EPA Clean Air Power Initiative to control: SO_2, NO_x and mercury (July 1996)

     New Processes for Efficiency Improvement and Reduced Emissions: (Coal plants)
     - Co-burning of waste tires (Ohio Edison, OH)
     - Atmospheric fluidized bed combustion
     - Pressurized fluidized bed combustion
     - Slagging Combustors
     - Combustion modifications (air/fuel ratio spacial variations)
     - Flue gas desulfurization
     - Regenerable flue gas desulfurization
     - Selective catalytic reduction
     - Selective noncatalytic reduction
     - Combined NO_x/SO_2 reduction

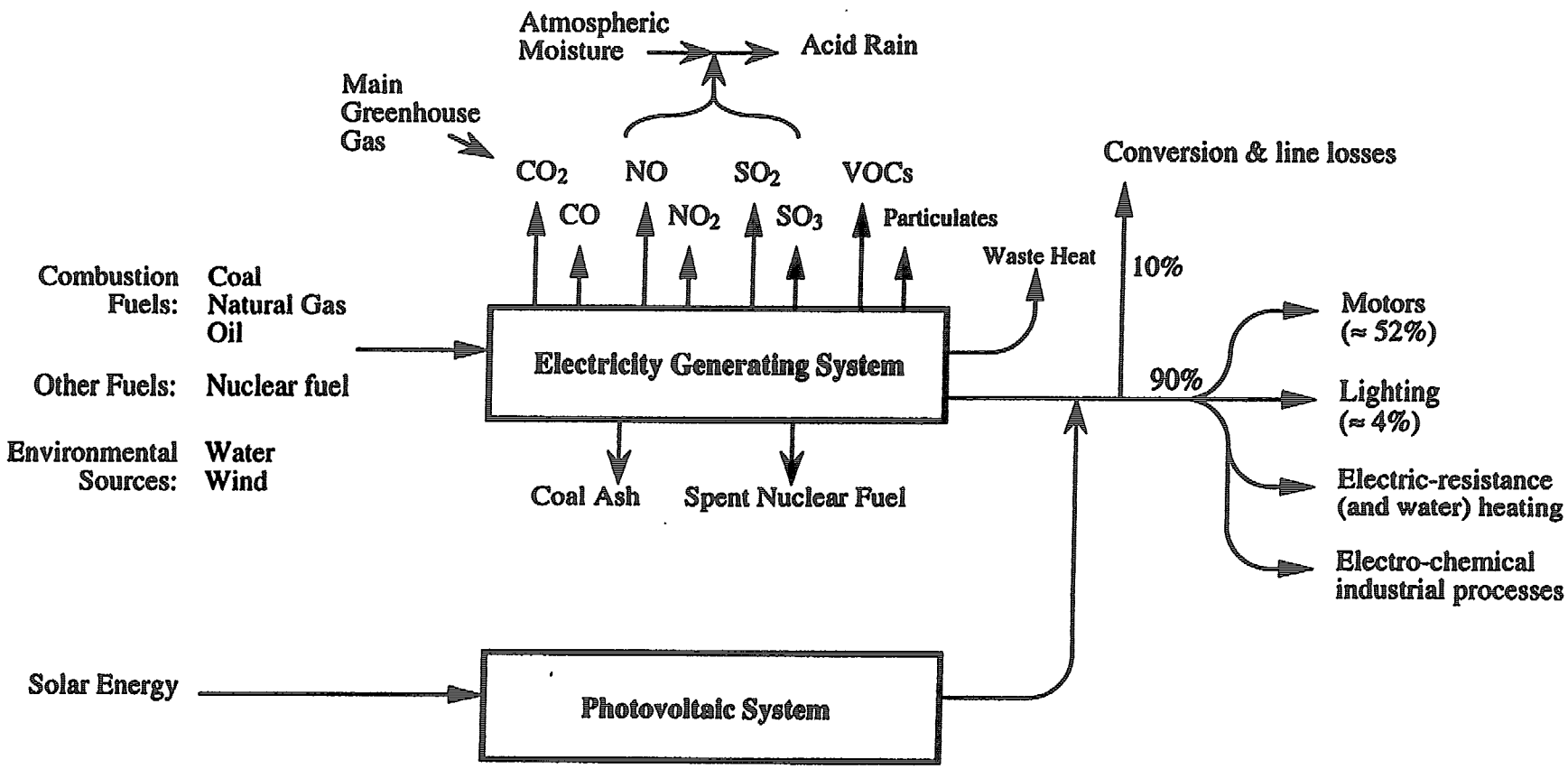
   - Nuclear Plants

     Concerns
     - High cost of plant construction and operation
     - Criticality control
     - Radiation safety
     - Disposal of nuclear waste

   - Photovoltaic Systems

     New Development:
     - Use of low cost copper indium diselenide cells (Tucson Electric Power, AZ); plan to manufacture 1.5 MW.

Schematic Diagram of Energy Conversions and Environmental Releases



Examples of Energy Conservation and Waste Minimization Interactions

Measure	Primary Measure of Saving	Secondary Effect
Utilize waste wood in boiler	Displace purchased fossil fuel	Minimize wood waste
Utilize synthetic lubricants	Increase mechanical efficiency	Reduce quantity of discarded oil
Improve lighting efficiency and delamp	Reduce electricity use	Reduce number of failed tubes discarded
Tune-up boiler and maintain efficiency of steam distribution system	Reduce fuel use rate	Reduce unburned hydrocarbons in stack gas
Recover solvent from paint drying oven stacks	Reduce solvent purchases	Reduce consumption of hydrocarbon fuels used to incinerate solvent vapors
Cover heated solvent tanks	Reduce heating energy consumption	Reduce solvent evaporative loss
Minimize produce rejects	Minimize product waste	Reduce manufacturing energy

Relationship of Industrial Technologies Programs* to the Seven Vision Industries

	Aluminum	Chemicals	Forest Products	Glass	Metal-casting	Petroleum Refining	Steel
Alternative Feedstocks		■	■				
Bioprocessing		■	■			■	
Ceramic Composites	■	■	■	■	■	■	■
Catalysis	■	■	■			■	
Cogeneration/Advanced Turbine Systems		■	■			■	
Combustion	■	■	■	■	■	■	■
Materials	■	■	■	■	■	■	■
Sensors	■	■	■	■	■	■	■
Separations	■	■	■			■	

* The Municipal Solid Waste and Solar Industrial Programs have general ties to the Vision Industries but are not specifically focused on these industries.

Impact of Environmental Laws on Industry

1. Actions Industry Must Take

   - Identify waste streams which are subject to regulation

   - Maintain records of regulated substances:
     Stored on-site
     Shipped off-site
     Releases to the environment

   - Handle on-site waste as specified by law:
     Allowable mixing
     Labeling
     Storage time limits
     Use of approved shippers

   - Periodically report:
     Off-site shipments of wastes
     Other intended releases to the environment
     Accidental releases

   - Establish programs for source waste reduction (pollution prevention)

2. Penalties for Violations

   - Fines

   - Plant shutdown

   - Criminal prosecution of responsible individuals (possible imprisonment if convicted)

Historical Evolution of U.S. Energy Legislation

1873 Coal Lands Act
This act outlines the terms by which the government will buy lands containing coal from private owners.

1910 The Bureau of Mines Act
This act establishes within the Department of Interior a bureau of mining, metallurgy and mineral technology. The bureau is responsible for investigating the preparation, treatment and utilization of mining materials and increasing the safety, efficiency and economic impacts of this industry.

1920 Federal Water Power Act (Federal Power Act)
This act created the Federal Power Commission and grants it the authority to investigate the utilization of water resources and issue licenses for the construction of dams, conduits and reservoirs.

1935 Federal Power Commission
This act imposes regulations on utility companies to improve their management structure and to monitor their economic situation.

1938 Natural Gas Act
This act allows the government to set pricing rates for the natural gas industry and to review the natural gas companies to improve their business operations.

1946 Atomic Energy Act
This act provides for the use of atomic energy for peaceful and military purposes and to oversee the facilities involved in the processing and utilization of atomic energy.

1975 Energy Policy and Conservation Act
This act creates a Strategic Petroleum Reserve that reduces the effect of severe energy supply interruptions. It promotes increasing the energy efficiency of motor vehicles and major appliances and conserving water through improving plumbing products and appliances. The measure also outlines the need to conserve natural gas supply by depending more heavily on coal resources.

1976 Energy Conservation Standards for New Buildings Act
This act identifies the wasteful consumption of energy used for heating, cooling, ventilation and providing hot domestic water in newly constructed buildings that lack adequate energy conservation features. The measure explains federal standards that can reduce unnecessary energy consumption and holds residential and commercial buildings responsible for implementing these recommendations.

1987 National Appliance Energy Conservation Act
This act applies the policies and standards of the Energy and Conservation Act to residential appliances.

1988 Federal Energy Management Improvement Act
This act initiates a survey of government buildings and provides for the improved maintenance and operation of these facilities to reduce associated energy consumption.

1989 National Energy Policy Act (National Energy Conservation Policy Act)
This act implements a program that includes site visits and technical briefings to inform the government about the implementation of conservation measures.

1989 Renewable Energy and Energy Efficiency and Technology Competitiveness Act
This act introduces a national program to ensure the stability of a future energy supply. The program includes making technology cost competitive, allowing for long-term federal research programs, motivating private sectors to use new technology and beginning research and development programs in the private sector.

1991 National Energy Policy Act (National Energy Conservation Policy Act)
This act promotes the use of energy efficient lighting and more efficient means of heating, cooling and solar space conditioning. This measure also provides for the use of demonstrations, new employees and managers to successfully implement these requirements.

1992 National Energy Conservation Policy Act
This act expands upon the National Energy Conservation Policy Act of 1991 by offering detailed suggestions and policies for certain facilities and industries.

Provisions of the Energy Policy Act (1992)

- Building Energy Efficiency Standards (new federal, commercial and residential buildings)
  - Building shell insulation requirements
  - Heating and cooling system operating efficiencies
  - High R-factor windows
  - High-efficiency appliances

- Lighting
  - Raises the minimum allowable efficiency (particular sources)
  - Fosters training, education and research (Energy Efficient Lighting and Building Centers)
  - Reduces the taxability of utility rebates
  - Labeling (Lamp efficiency)

- Mortgages for Energy Efficiency Improvements
  - The Department of Housing and Urban Development can make 100% home loans for financing the installation of energy efficiency improvements (including insulation, windows and doors, heating and cooling systems)

- Appliances and Motors (Efficiency standards and labeling rules)
  - Electric motors
  - Electric water heaters
  - Electric air conditioners and heat pumps
  - Furnaces and boilers

- State Programs
  - Energy conservation program

- Federal Energy Management Program

- General Services Administration
  - Energy management in leased space

- Performance Contracting for Energy Efficiency Improvements
  - Provides the legal framework to facilitate federal agencies in the securing of private sector financing via "energy savings performance contracts"; costs for improvements obtained from energy savings.

- Alternate Fuels
  - Natural gas-powered vehicles
  - Electricity-powered vehicles

- Electricity Policy (Utilities)
  - Promotion of energy efficiency
  - Integrated resource planning
    - new generating capacity
    - power purchases
    - energy conservation and efficiency
    - cogeneration and district heating and cooling applications
    - renewable energy resources
  - Life cycle costing
  - Demand side management

- International Issues
  - Markets
  - Renewable energy
  - Global warming

- Taxes and Revenue Provisions
  - Energy conservation and production incentives
  - Utility subsidies
  - Clean fuel vehicle deduction
  - Solar and geothermal property investment credit
  - Local furnishing of electric energy or gas
  - Electricity produced from wind and closed-loop Biomass
  - Alcohol fuels
  - Employer-provided transportation benefits
  - Depletion/intangible drilling costs
  - Other incentives

- Industry and Economic Growth
  - Promotion and commercialization of attractive new emerging energy technologies via
    - Research and development
    - Application and demonstration programs

February 15, 1998

Module II

Green Lights' Economics

Purposes of Cases as Pedagogy

Choreographing a Case Class

Pollution Prevention and Finance
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Green Lights' Economics: Graphic Design Considers a Lighting Upgrade

By Michael Tucker, Associate Professor of Finance, Fairfield University

A Phone Call Gets the Ball Rolling

Sam Taylor, owner of Graphic Design, had just received a call from Bob Jackson of Energy Solutions offering a free, no-obligation lighting audit. Using the audit, Jackson would determine how much electricity Graphic Design's lights used and propose an alternative system.

A lighting audit wasn't exactly at the top of Sam's "do-it-now" list. Although he recognized the importance of good lighting, it was something that he thought he had taken care of five years earlier when he redesigned the building's interior and had the current fixtures and bulbs installed. It had cost plenty at the time and seemed to be working fine—why should he replace anything now? Jackson responded that Graphic Design's lighting system was probably using considerably more electricity than necessary.

At nine cents per kilowatt hour (kWh)[1], electricity was not cheap. Then again, thought Taylor, the expense wasn't hurting his bottom line. He was also concerned that the cheaper lighting might be of lower quality. Jackson assured him that this was not the case. Finally, there were rumors, not scientifically substantiated, that radioactive material in the ballasts could be harmful.

Because Taylor owned the building, a lighting upgrade sounded more palatable than if his company had been a tenant. Still, it was likely to cost more than Taylor wanted to spend on something that didn't seem to need fixing. He wondered if that money might be better spent on new equipment or software instead of high-tech lighting Then Jackson mentioned that South Norwalk Power and Lighting (SNP&L) would pick up half the cost of any installation as part of its program to reduce electricity usage. Taylor sensed a bargain and his interest went up a notch. He invited Jackson to inspect his building the following day.

[1]For example, an appliance that draws 1,000 watts for one hour has consumed 1 kWh.

Reducing Greenhouse Gases With "Green" Lights

When Jackson arrived, he described the United States Environmental Protection Agency (U.S. EPA) program from which he had received his training in the energy-efficient lighting business. Called Green Lights, the program reduces power plant emissions of carbon dioxide (the biggest contributor to global warming) and other greenhouse gases by encouraging participants to install energy-efficient lighting.

Greenhouse gases prevent or inhibit heat generated at the surface of the earth from escaping. Venus is an example of an extreme greenhouse effect: the predominantly carbon dioxide atmosphere traps the planet's heat, keeping surface temperatures around 800° F. While Earth is not about to become like Venus, explained Jackson, scientists have concluded that human-induced changes in atmospheric composition (i.e., increasing emissions and the accumulation of greenhouse gasses) are creating greenhouse conditions, and global warming appears inevitable. The degree to which it will occur depends on what actions humanity takes in the near-term to reduce emissions. At the 1992 United Nations Convention on Environment and Development, global warming concerns prompted major industrial nations to agree in principle to roll back carbon dioxide emissions to 1990 levels. Changing to energy-efficient lighting is a small step toward accomplishing this goal.

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Green Lights participants typically reduce the lighting portion of their electricity bill by more than half and often improve lighting quality. Although rebates from electric utilities have been a big motivator in some areas of the country, internal rates of return (IRRs) average 47% — this benefit, along with the environmentally positive nature of the program, is often a sufficient motivator for another company to participate in Green Lights.

Environmental stewardship was a major focus of interest at the local high school. Lately, Sam Taylor had been hearing about it from his teenage son. If he bought into this Green Lights program, he could show his son that he was doing more than just talking about making a difference. Of course, if he could "do well [financially] by doing good," all the better.

Can Green Lights Save Money Too?

Jackson explained that utilities, for their part, were not handing out rebates purely out of generosity. Reductions in peak power usage meant lower construction budgets for new power plants. A one-kWh reduction in electricity demand translated into $1,500 of future construction costs deferred or possibly avoided.

To Taylor, Green Lights sounded like just the type of program the country needed to get away from government bureaucracy and still make progress on taking care of the environment. Without being subjected to any new regulations, laws, or threats of fines, companies participating in Green Lights, by cutting their demand for electric power, are reducing future carbon dioxide emissions from power plants by 1,750 million metric pounds per year.[2] This is the equivalent of taking 165,000 cars off the road annually. Major reductions in sulfur dioxide and nitrogen oxides are also being accomplished. In addition to cleaning up the air and cutting back on greenhouse gases, the 1,753 participating companies are going to save at least $98.1 million per year on their future electric bills. This is only the beginning of what is possible: if all eligible companies invested in lighting upgrades, potential energy savings could be as high as $16 billion per year; resulting reductions in carbon dioxide emissions would equate taking a third of all cars in the U.S. (44 million) off the road.

Although the big picture sounded great, Taylor needed to get a handle on what could be done at Graphic Design and what it was going to cost him. The future savings Jackson talked about would have to be large enough to overcome any up-front expenditures. There was also the possibility of selling the old lighting system. Jackson had intended to haul it off to the dump but said it could fetch a few hundred dollars.

One area of savings would be reducing the fixed cost component of Graphic Design's electric bill. Jackson explained that once a year SNP&L measured electricity demand. Based on what a firm was using at that time, the utility estimated the company's peak kilowatt demand. It was the utility's obligation to have adequate capacity to meet the highest likely (peak) demand of Graphic Design and all the other companies and homes on its power grid. For maintaining this capacity, SNP&L charged each company a "peak demand charge": $5.00 per month for every kilowatt measured during the annual visit. If Graphic Design reduced its peak demand, its monthly peak demand charge would also go down. Currently, Graphic Design's annual peak demand charges alone totaled $271.94 (including 6% sales tax).

The Proposal and the Decision

After surveying all the fixtures and querying Taylor on how many hours each light was in use, Jackson briefly described his proposal. First, he would estimate current annual kWh used per fixture and calculate annual electrical costs based on the nine-cent-per-kWh rate charged by SNP&L. Next, he would estimate the reduction in annual kWh consumption that could be accomplished through three methods: (1) installing motion sensor devices that would automatically turn lights off when no one was in a room, (2) replacing the ballasts in the fluorescent fixtures with more efficient ballasts, and (3) replacing the existing fluorescent tubes with tubes requiring less/lower wattage.

Two days later, Jackson faxed Taylor a proposal outlining current usage and potential savings (Table 1), a guarantee that the reductions would actually be realized (Exhibit 1), and a memo detailing the impact of those reductions (Exhibit 2). Energy Solutions' total charge for the installation would be $2,500.

Even though Taylor was impressed by the savings and was looking forward to showing the memo to his son, he still had a few financial questions.

[2] As of March 31, 1995; EPA estimate.

TABLE 1: LIGHTING ENERGY ANALYSIS

Current Lighting System

	Number of fixtures	Lamps per fixture	Wattage	kW	Annual hours of use	Annual kWh usage
President's Office	2	4	168	0.336	2,250	756.0
Signs	6	2	30	0.180	8,760	1,576.8
Loading	2	4	168	0.336	2,250	756.0
Kitchen	1	4	168	0.168	2,250	378.0
Bathroom	1	2	84	0.084	1,000	84.0
Workspace 1	2	4	168	0.336	2,250	756.0
Bathroom 2	1	1	60	0.060	500	30.0
Entrance	1	4	168	0.168	2,250	378.0
Workspace 2	4	4	168	0.672	2,250	1,512.0
Other	13	4	168	2.184	2,250	4,914.0
				total kW demand: 4.524	total kWh consumed: 11,140.8	

Proposed Lighting System

	Number of fixtures	Lamps per fixture	Wattage	kW	Annual hours of use	Annual kWh consumption
President's Office	2	4	106	0.212	1,125	238.5
Signs	6	2	11	0.066	8,760	578.2
Loading	2	4	60	0.120	750	90.0
Kitchen	1	4	60	0.060	1,125	67.5
Bathroom	1	2	60	0.060	500	30.0
Workspace 1	2	4	106	0.212	1,800	381.6
Bathroom 2	1	1	15	0.015	500	7.5
Entrance	1	4	60	0.060	2,250	135.0
Workspace 2	4	4	106	0.424	1,500	636.0
Other	13	4	106	1.378	2,250	3,100.5
				total kW demand: 2.607	total kWh consumed: 5,264.8	

	utility charge	tax	savings
Peak Demand Reduction: 1.917 kW	**$5.00 * 12 months**	**0.06**	**$121.92**
Annual Use Reduction: 5,876 kWh	**$0.09/kWh**	**0.06**	**560.57**
		Total annual savings	**$682.50**

EXHIBIT 1

Energy Reduction Guarantee

Customer: Graphic Design
130 North Avenue
Norwalk, Connecticut

Energy Solutions hereby guarantees a reduction in kilowatt usage, as outlined in the Lighting Proposal, which, in turn, shall yield specific financial savings.

Graphic Design is guaranteed that upon completion of the retrofit there shall be a reduction in lighting energy demand of 1.92 kWh, plus or minus 10%.

Graphic Design agrees that the Current Lighting System as described in the Lighting Energy Analysis is a correct representation of the building's present system.

Any disputes as to the effectiveness of the new retrofit system's ability to reduce Graphic Design's kW load shall be settled by taking wattage readings from a reasonable number of fixtures to determine the new kW load. The number shall be compared against present lighting system kW load. In the event that kW savings fail to meet those promised (above), Energy Solutions will pay the difference between savings promised (minus 10%) and savings attained that would have accrued for the subsequent two years.

Energy Solutions is not responsible for changes in the financial analysis due to increases (decreases) in utility rates or customer operational hours.

_____

Robert Jackson
Energy Solutions

EXHIBIT 2

Environmental Memo

To: Sam Taylor, Graphic Design

From: Bob Jackson, Energy Solutions

The EPA estimates that, on average, installing the proposed lighting system will accomplish the following environmental goals every year:

Energy Consumption Reduction:	5,876 kWh
Reduction of Coal Consumption	4,701 lbs.
Reduction of Carbon Dioxide Emissions	3,056 lbs.
Reduction of Sulfur Dioxide Emissions	53 lbs.
Reduction of Nitrogen Oxide Emissions	29 lbs.

This installation is the equivalent of removing 0.28 automobiles from the road every year savings are achieved.

Questions

1. Taylor wanted to know how much his savings would be if he only installed the motion sensors (thereby reducing the hours of light usage) compared to the savings he would accomplish by only installing new ballasts and lamps (thereby reducing energy consumed per hour of usage).

2. Having been a business major in college, Taylor was familiar with net present value (NPV) analysis. He wanted to know the NPV of the installation's cash flows, taking into consideration that any of his savings would be taxed 31% by the federal government and 4.5% by the state. The 50% rebate offered by NP&E would save him $1,250, but the 6% state sales tax would apply to the entire $2,500 cost. For tax purposes, Taylor intended to expense the entire cost of the installation. Looking at 10 years worth of cash flows would be sufficient for the analysis. When Taylor first prepared a business plan for his company, he applied a 20% discount rate to projected cash flows. He recalled from a college finance course that, in some cases, it was appropriate to apply a risk-free discount rate to cash flows if there was no uncertainty attached to their occurrence. Currently the Treasury Bill rate was 6%. Of course, calculating the IRR would also be useful, particularly given his uncertainty about which rate to use; it was also a calculation that the EPA required of its Green Lights participants.

3. Taylor knew that SNP&L would not be keeping rates at 9¢/kWh forever. Assuming future inflation to be 3.5% per year, he wondered what the installation's NPV would be, beginning with the following year, when he would begin realizing savings from the installation. Concomitant with rate hikes was the assumption that the local economy would be improving and Graphic Design would be getting more work. This would lead to expanded hours of operation, with both workspaces being used up to 5% more each year for the next seven years, by which time their use would be maximized. What would the incremental NPV of Taylor's savings be under this scenario? It would be useful to take a look at NPV under a range of possible rate hikes from 0% to 7% to get a better idea of just how good deal this might be.

4. What are the financial and environmental implications of selling the old lighting system? By selling it, does Graphic Design perpetuate the use of inefficient equipment?

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The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 313-764-1412
• Fax: 313-936-2195
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materialsand conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education.*

We're Going Online!
The NPPC provides information on its programs and educational materials through the Internet's Worldwide Web; our URL is: **http://www.snre.umich.edu/nppc/**
Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!

PURPOSES OF CASES AS PEDAGOGY

PROBLEMS ENCOUNTERED	REQUIREMENTS FOR SUCCESS	EVALUATION
Student impationce or boredom	Student is concerned, feels problem exists and desires knowledge	Student interest, knowledge retention and ability to playback
Student awareness, unconcern with problem to which problem addressec	Studnet desire for concept after wrestling with problem in absence of conceptual scheme	Grasp of ability to playback
Student failure to see usefulness, practicality, or relevance of technique.	Student comprehends need for technique before; ability to see derivation	Ability to work problems correctly
"It seem s too easy/hard" "It seems too universal/limited"	Realistically demanding case. Teacher restraint	Practicality of student recommendations
Teacher domination, telling or solving.	Student willin to work, desires to analyze problem and feels competent	Throughness, variety, completeness of analysis; breadth and depth of analysis ç
Teacher tempation to settle with own "ingenious" analysis.	Student believes has necessary facts and is challenge to develop solution which he/she believes exists	Creativity and realism of action plans.
Teach imposition of own attitudes and values	Teacher trusts that attitudes emerge as a long-term by product of vicarious expeirence	C hanges in attitudes, increased confidence, responsibility, and humility
Teacher impatience; inability to tolerate student frustration	Teach can tolerate student frustrations	Waiting and trusting.

PURPOSES OF CASES AS PEDAGOGY

EDUCATIONAL OBJECTIVE	APPLICATION	TEACHER'S ROLE	STUDENT'S ROLE
Memorize Facts	Very Poor	Narrate, Expose, Enlighten with Expertise	Listen
Develop Concepts	Poor	Explain taxonomies and interrelationships	Listen and question
Understand Techniques	Poor	Explain technique, its derivation and application	Work problem, examples; Derive technique
Acquire Skills in Use of Technique	Good	Question and probe to develop realism	Work out effectiveuse of technique in business situation
Acquire Skill in Analysis of Problems	Excellent	Probe, Clarify, Interrelate	Analyze; Determine cuase/effect relationships;
Acquire Skill in Synthesis of Action Plans	Excellent	Challenge, Question, Extrapolate, and Role-play	Establish priorities; plan of action; Develop possible outcomes and implications
Develop Useful Attitudes	Good	Lift up the problem of executive attitudes	Discuss/debate outcomes; Personalize
Develop "Wisdom"	Good	Give Feedback, Restate, Listen	Discuss-'Debate;'Develop alternatives and their implications.

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Choreographing a Case Class

Broadly classified, case class teachers use one of four approaches:

- 1) Lecturing a case;
- 2) Theorizing a case;
- 3) Illustrating a case; and
- 4) Choreographing a case.

While each of them may be just as impressive in the classroom, from an instructional viewpoint, this note contends that the last method (i.e., choreographing a case class) is probably most effective from a learning point of view. Each of the other methods, however, have a role to play over the length of a case course. By using the appropriate approach, judiciously instructors will be able to improve their teaching impact.

Lecturing a Case

Here the instructor literally leads the class through a case analysis, pretty much following the sequence that he/she feels is most appropriate, and emphasizing those parts of the analysis that the instructor feels are most useful. By the end of class, students receive a superlative analysis of the case from one instructor's point of view. Clearly the student enthusiasm for the knowledge gained will depend on the power of the instructor. Some instructors who have the class presence and an appealing lecture style (this could vary from humor to intense argumentation) usually end up doing quite well. Students of such instructors will usually write an evaluation at the end of the semester documenting what a great lecturer they had. But the real question is: how much did the students learn?

Theorizing a Case

Here is a style where the instructor essentially uses the case as a vehicle to convey conceptual or theoretical knowledge. Of course the success of such a class may rise or fall depending

Professor V. Kasturi Rangan prepared this note as an aid to case method instructors.

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on the contents of the theoretical lecture itself. If the instructor has been able to take a holistic view of the case (including several angles to the analysis) in presenting the theory, then the lecture is more credible than using only selected parts of the case to illustrate the theory. Very often the same case might lend support to the theory when viewed from one point of view, but also falsify the theory when viewed from a different perspective. A good instructor will usually reconcile these disparate views. When students write their course evaluations at the end of the semester, they are very impressed with how brilliant and intellectual their teacher was. But the real question is: how much have the students learned?

Illustrating a Case

This is a technique that is often used by management consultants and speakers doing the popular business circuit. Here the aim is to use the case as a war story to illustrate certain important management ideas. The success or failure of the class will rest on how relevant the war story itself was in illustrating the management issue, and on how widely assorted are the other war stories that supplement the case story. Of course, when done poorly, this approach only ends up trivializing the case. When done well, this could be quite entertaining. At the end of the talk when the audience members write their evaluation they will say how worldly-wise, experienced and impressive the speaker was. But the real question is: how much have the students learned?

The Learning Process

While each of the above methods of leading a case discussion could be effective if done well, I must submit that none of them really address the learning philosophy of case teaching. I submit that case teaching is not a tactical pedagogical tool, but rather the very heart of a teaching strategy. A truly effective case instructor relies on his/her students to learn inductively from the case data. In comparing a series of cases and contrasting them with each other, students should learn to slowly construct a framework built out of relevant information, consolidate it and sharpen it as a robust way of understanding not only the case issues discussed, but also as a useful platform to support future thought on related issues. Management is a social science. Managers and consumers and competitors and distributors and regulators and advertisers have all gotten together to create the context within which our frameworks hold. Our frameworks are nothing but relative theories; they are relative to the context and to the time. That is why most Marketing concepts and frameworks are inductive, driven by real data and real actions of real players. Before we make a prediction on how the same set of relationships will play out in a different context, we must absolutely have a good understanding of the players involved and the context of the play. In short, our frameworks have to be creatively adapted. That is why I do not subscribe to any of the above case teaching methods.

Choreographing a Case Class

I believe in choreographing a case class. An instructor teaching by this method leads students through the key conceptual and decision issues in the case without necessarily pre-judging the correctness of their students' contributions. After all, if the case is an instrument to stimulate inductive frameworking, then a healthy vigorous debate on the merits of an argument are an absolute cornerstone of a good case discussion. I am not suggesting that the instructor should not have a point of view; all I am saying is that the instructor should not pre-suppose that his or her point of view is the most accurate. Neither do I suggest that "wrong" analyses should be pardoned, but that patient discussion, rather than instructor, first should expose the faulty premise. It behooves a good case instructor to lead the class through the critical issues, insuring that different

but relevant points of view are aired out and that faulty ones are identified and understood for their weaknesses and flaws. A good case instructor does not intellectually dominate the case discussion. If students have to learn how to build frameworks inductively, they should also be responsible for taking a stab at putting the building blocks together. A good case instructor gently nudges them through the important topics. Ultimately it is the instructor's responsibility to lead the class to a conclusion. That conclusion should be a broad, thoughtful characterization of the various relevant viewpoints and how they provide the building blocks for understanding the topic under consideration. Choreographing a class discussion is risky business. A poorly choreographed class could be a disaster, with the case leader playing a no more important role than a lousy traffic cop, who essentially just decides who the next speaker should be and faithfully uses the board or the flip chart to record the arguments. Such a class ends in total cacophony and results in no learning, no entertainment, and no transfer of knowledge. That is why many instructors prefer to use one of the other three methods (lecturing, theorizing or illustrating a case). These methods are somewhat more under the control of the teacher. At worst one can pull off an average class, and at best pull off quite an impressive class. But the real question is, do any of these methods truly allow students of management to inductively build their thinking capability and learn how to build frameworks and adapt them to a different context? My answer is a guarded "NO." The only reason I am not more emphatic is because each of the other case teaching methods has a lot to contribute, if used sparingly at appropriate points in the course. I believe, however, that the choreographing method should be the "staple" style. But when bringing a module of cases together, a theorizing style might be helpful, because in the previous classes students would have already generated their frameworks and may be eager to get convergence. The lecturing method is often useful when exploring a new phenomenon, and the illustrating method when discussing implementation issues. But in any case, they should all supplement each other with the choreography method providing the central anchoring role. There are many articles and books written on the topic,[1] and I do not intend to bore the reader with minute details, but in this article I would simply like to summarize some of the key points of an effective case class.

There are four sections to a good case class.

I. Decision Orientation

Regardless of whether the action planning is the opening or final question, or buried someplace in the middle, a good case class should always ask the question: what would you do if you if you were the case protagonist? The reason for being action oriented is very simple. Ultimately it is this question that forces the analysis and the reconciliation of disparate evidence and mobilizes them all into one over-arching direction-- the Action Plan! There is always a tendency, especially in an MBA class, to procrastinate and seek armchair refinement. While it may be possible to do so in some cases, the decision maker has neither the time nor data to resolve all puzzles in most others. Judgment despite uncertainty is essentially the art of management. And so, forcing the student to reconcile these pieces of evidence results in a stronger analysis because students then learn to make the tradeoffs, they learn to prioritize, and they learn to make judgment calls on which piece of analysis they attach a greater value to. Moreover, the advantage of asking an action planning question is that it brings the different perspectives to the foreground. In a sense it sharply contrasts the different ways of looking at the evidence, and this lets the instructor get into the details of the framework and debate the various contingencies that drive the framework.

[1]See for example, Teaching and The Case Method, by C. Roland Christensen and Abby J. Hansen, HBS Press, 1987; and Education to Judgment, edited by C. Roland Christensen, David A. Garvin, and Ann Sweet, HBS Press, 1991.

II. Themes/Analyses

While any good case has a dozen interesting bits of analysis that could be driven by a dozen or more good questions, one should remember that in a one-and-a-half-hour or even a two-hour class there are bounds on rationality, and students can comprehend only so many themes. I have found that going into class with four or five thematic areas is more than sufficient. Any more than five themes is really too many. The instructor's role then is to prepare the three to five themes, and to know why these are the most important for the case context on hand. It should also be the instructor's role to show how these thematic areas link to each other. Be it teaching notes, 3x5 cards, or whatever, I like to walk into class with those themes and also a sense of how the various themes hang together, and the knowledge of the range of arguments that one might expect within each theme from the class. But within each theme, the debate that drives one point of view versus the other is at a level of detail that is best covered by the class rather than the instructor, whose role is only to provide the opportunity for the debate to be aired out. Sometimes it may be important to drive the themes sequentially, in which case the instructor should take the leadership role in doing so. At other times, the ordering of the themes may be less important than the debate within the themes themselves. In any case, when making the transition from one theme to the other, it is the responsibility of the instructor to clarify and summarize the outcome of that discussion. Many times there will not be a clear consensus as one moves from one theme to the next. There is nothing wrong with that; it is only the instructor's role to highlight the range of the arguments before moving on to the next topic. It should also be the instructor's role to clearly point the way to the next theme, and this is best achieved by building on the class's momentum. Many times this can be done in a very subtle fashion, using the students themselves as the right leverage for transition, but at other times the instructor, in the interest of managing the class time, may want to effect the transition move.

III. Structure

Structure is a very important part of any case discussion. There are two components to it. The first component is the amount of time that should be allocated to each of the major themes, and when the transitions should occur, but the other aspect of structure is using both verbal and visual cues for the class to constantly see how the themes build and how they link to each other. Some of it is done through the transition device between themes already discussed in the previous section, but one should use visual cues to direct the structure as well. Some instructors are very good at capturing the class comments and writing them neatly and legibly on the boards, but many of us fall prey to writing illegibly and in a manner which only we can decipher. The poor student is left to make sense of this visual mess. By capturing some of the thematic arguments and the end points of the debate on the boards and flip charts, one can run a very effective class structure. This is one of the biggest weaknesses of case teachers; many of them do not view what and how they write as being important contributors to the overall learning. One has to keep in mind that it is less important to know exactly what you will write, but rather more important to know what the headings of the various titles that go up on the boards will be, and even their spatial position. At the other extreme, capturing every student comment neatly and legibly on the board is a big waste of time. The primary job of a case teacher is to LISTEN. Only the thematic headings and substantive guide posts that enable the class to build consensus or argue its merits needs to be written. The board is not a word-processor to capture everyone's arguments in detail.

IV. Closing

It is useful to remember that in an inductive learning effort one hardly teaches a case; what one is trying to do is teach a bunch of cases which all act as stimuli to create an understanding of an

the underlying framework. It is very useful to allocate some time to compare and contrast the cases preceding the immediate case discussion. Sometimes it might mean surfacing relevant examples to illustrate the concept, or it might even involve tracking ideas from an article and relating it to the case. At other times this segment could be used to go out of the case itself. One can change the parameters of the case creatively, or pose new situations and contexts, and do a "what if?" analysis. Such an exercise subjects the framework that students have been actively developing to a test of its validity and credibility. It's really a check for its robustness.

And, finally, every case class concludes with a summary. The summary should not be merely the instructor's analysis of the case. It should be a reflection of the themes that were developed in class. It should show the linkages between themes, it should underscore the arguments within these themes, it should show how these arguments finally hang together, and it should show what kind of action planning judgments can be made from a reasonable analysis of the data. While de-briefing students on what the case protagonists did, one should always be careful to point out other good alternatives existed, if they existed. It is not always the case that the actions taken by the company were the best under the circumstances, and it is useful to underscore that right at the outset of a case course.

Conclusion

Having highlighted the composition of a good case class, let me address a few process issues. First of all, it is important to legitimize a piece of analysis or an action plan that later on turns out not to be a mainstream point. It is important for the instructor right from the beginning to support and acknowledge those points of view, because without such a contrast it is highly unlikely that the mainstream point of view could emerge so solidly. Instructors who in their anxiety to reach the final picture beat down on these diverse points are likely to find themselves with a somewhat uncreative consensus style as the term progresses. The class will attempt to appease the instructor's biases, rather than address the merits of the business situation. The only bad comment in a case class is one that is based on sloppy preparation, or a comment that has not been fully thought out. All other comments which are based on a reasonable inference of the data are all good analysis, regardless of the final outcome. It is also important in a good case discussion to involve a broad cross-section of the class. People who articulate a particular point of view get committed to it and process subsequent information much more actively than passive participators in class. So it is the responsibility of the discussion leader to draw broad participation; even a quick one-minute comment can energize a person's learning in the class discussion. It is also a good tactic to raise questions of clarification, doubts and disagreements in class by asking other students to comment on their fellow student's point of view. This way the class takes the responsibility for reconciling the different points of view, or if they are irreconcilable, to understand why they are so different. The instructor should jump into the debate only when there is no other avenue, or to bolster a minority argument, or to provoke deeper thinking.

On the question of how much analyses and how much action planning and in which sequence, my answer is: it depends. First, one has to be sensitive to the nature of the case material. Often it will be impossible to discuss action plans without a deep understanding of some core analytic issues. At other times, even if it is possible to get to the analyses via the action plan, instructors may want to set a reflective tone in class by seeking the analyses first. But many times, a decision-oriented start will enable an instructor to achieve his/her teaching goals and get a spirited action debate going simultaneously. There is no one way to effectively sequence a case class.

All in all, teaching by the case method requires two sets of preparations: the first one is the case analysis to understand the arguments and issues of the case, and this is the easy part of the preparation. The more difficult part is the one that maps out the themes, the flows, the sequence, and the structure. It is difficult to put a time estimate on how much it takes for a good case preparation, but a rough rule of thumb would indicate that it requires about three to four hours of case preparation, and one to two hours of process preparation. When done well, a case class is a tremendously rewarding experience for the instructor. It is not as physically tiring as the other case teaching methods, but it certainly is more mentally tiring, as a case leader has to be constantly on top of every comment that is made. Good listening is half the challenge. These comments have then got to be woven into themes and concepts that the instructor would like to underscore and build. A good case class is one where, with the instructor's help, students learn and build, and learn how to learn.

February 15, 1998

Module III

PowerHouse Quick Start Tutorial

PowerHouse Quick Start Tutorial

Before You Begin

First, make sure that your game is properly installed and running. If you have problems, refer to the Technical Tips section of this booklet. If you can't find the answers there, contact the Impressions Technical Support Line for assistance. Information on where to get help is listed in the Technical Support section of this booklet.

This game requires a mouse. When you are told to click on something, move the mouse pointer to the indicated position and click the *left* mouse button unless the instructions tell you to use the right one instead. In general, when playing **PowerHouse**, the left mouse button takes an *action*, while the right mouse button provides *information*. Some commands can be activated through the keyboard by pressing the key corresponding to the underlined letter in the command, if you find that easier.

Before starting the tutorial below, you should get out the Quick Reference Card included with the game and keep it nearby as you play. Other useful diagrams can be found in the PowerHouse Game Manual, particularly the Main Game Screen display and key on pages 17-18, and the diagram of the Survey Results Screen on page 25.

Anything printed in bold type, **like this**, is something printed on the actual game screen that you should look for. Anything printed in bold italics, ***like this***, is an especially important game play note.

Once you've begun the tutorial, you can exit it at any time by clicking on the **File** menu on the Menu Bar, and selecting **Exit** from the list that drops down. You can also **Restart** your tutorial game from this menu, as well as **Save** it and return to it at a later point, if you wish.

Note that the strategies given in this manual are not necessarily the best strategies to use in the actual game. They've been chosen to give you the clearest introduction to the major aspects of the game, not to make sure you win from the start.

Double-click on the PowerHouse icon to start the game. The **PowerHouse Startup Box** will appear. Choose **Quick Start New Game.** You will be playing as the Blue corporation in this tutorial, and starting with M$2,000 ($2,000 million) in capital funds — an average amount.

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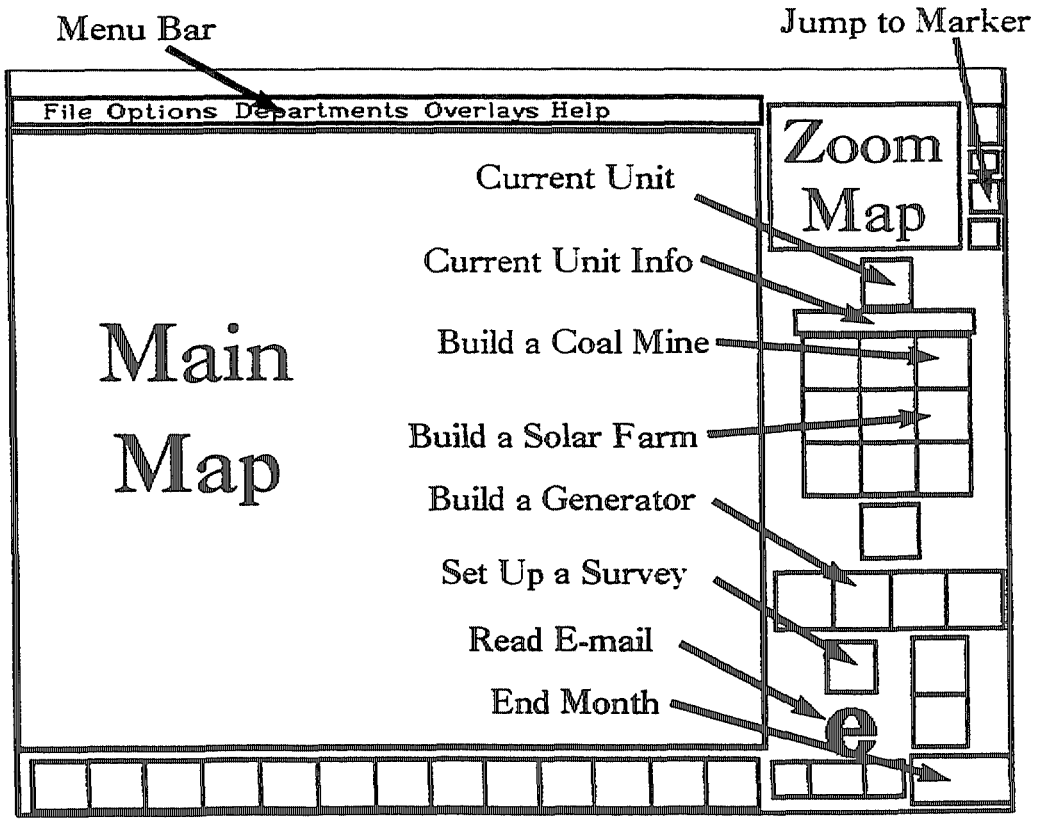
A Quick Overview

In PowerHouse, you play the CEO of an energy development corporation, trying to survive and grow in an energy-poor world. The world is divided up into roughly sixty large territories, each with its own energy resources and needs. The United Nations has taken charge of "opening" these territories to the four energy corporations who would like to operate there. At the start of the game, only one territory is open. If you and your rival companies are successful in meeting the energy needs of the first territory, the UN will slowly open more territories for you to develop.

To develop the world's energy resources, you first ***survey*** the land to determine what locations have what kind of resources, then you build ***sites*** of various types to extract the energy from those resources. You also invest in ***research and development*** to try to increase the level of technology available to you for these tasks. You are always competing with the other three corporations, all of whom are also looking for rich energy sources to exploit and trying to develop new technologies to take advantage of those resources more efficiently. Each energy unit produced by your corporation earns your corporation one million dollars in income, less any royalties and fees you may have to pay.

The Main Screen

Below is a diagram of the layout of the PowerHouse main screen. The left part of the screen holds the *Main Map Window*, while the right one-third holds the *Control Panel*. Only those areas which you need to be familiar with for this tutorial are marked. For a more complete diagram of the main screen, take a look at pages 17-18 in the main Game Manual.



Look in the main map window. You'll see part of a territory showing the general terrain. Dashed lines on the map show the borders of the different territories. Open territories are bordered in red, while closed territories are bordered in black. Remember that ***opened*** territories are ones in which you can build and develop your sites, while ***closed*** territories are barred to you and your rival corporations. If you attempt to survey or build in a closed territory, the UN will not allow it.

You should be looking at some part of this first open territory. Somewhere inside the border of this territory you should be able to find your ***marker***, a small square crosshair icon. The use of the marker will be described in a moment.

You can scroll around the map either by moving the mouse pointer to the edge of the screen in the direction you want to scroll, or by pressing the arrow keys on your keyboard. You can jump around the map quickly by using the *zoom map*, the small map of the world in the upper right corner of the screen. The black box outline on this map shows you what part of the world is currently visible in the main map window. Click on some other part of the zoom map with the mouse pointer, and the view in the main map window will jump to that location.

You can look all around the world map this way, but you can't do anything in most of the territories because they're still closed. To get back to the open territory quickly and easily click on the *marker button*, the third box down in the column of four small boxes just to the right of the zoom map. This will immediately bring you to the marker location.

Set Up Surveys

Before you start building energy-producing sites, it's a good idea to survey the land first. You don't *have* to — you can just start constructing sites blindly if you want — but you'll probably wind up with sites that don't produce energy.

You start off the game with one survey team already hired, but you will usually want more than one on staff, to increase the amount of territory you can survey at one time. From the Menu Bar, click on **Departments**. Select **Personnel — Survey** from the list. The **Survey Personnel** panel will appear. In the center of the panel is a pair of up and down arrows. Click once on the up arrow to hire a second survey team, then click on **OK** to return to the main screen.

Before you start placing your survey teams on the map, you need to know the rules under which survey teams operate. Each survey team investigates the tile it's placed on, ***plus*** one tile on every side of its own tile, including diagonal tiles. Thus, a single survey team can check out a total of nine tiles at once. When placing survey teams, it's a good idea to place the teams far enough apart so that

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their survey areas don't overlap, just to be efficient. The rules for where you can and can't place a survey are as follows:

- You can't place a survey team directly on top of the survey team for another corporation, and you won't get survey results for a tile currently occupied by another corporation's survey team.

- You can't survey a location that's already been developed by another corporation at all. Not only can't you put a survey team on top of the site itself, but if you try to survey right next to a developed site, your team won't get any information from that tile.

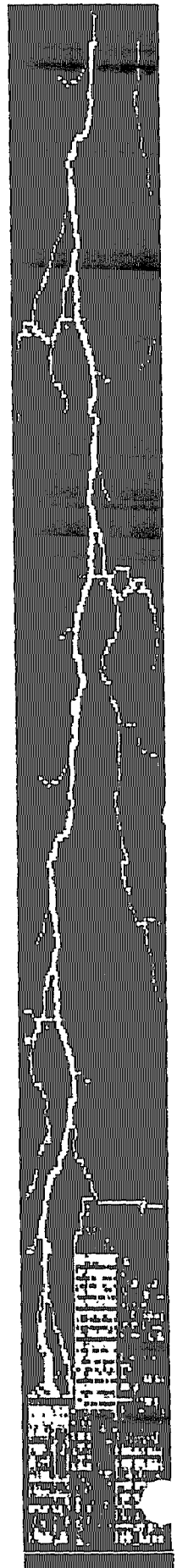
- You can't survey "across the border" into unopened territories, so it's better to keep your survey teams at least one square away from the edge of the territory so they can investigate their full nine tiles.

If you want, you can just start setting down survey teams in any location that looks interesting. But it's a better idea to get some more information first, to help guide you in deciding where to put your teams. Go to the menu bar and click on **Overlays**. From that menu, choose **Deposits & Surveys**.

Now look at the nine boxes near the middle of the control panel that show pictures representing each of the nine energy types. Click on each one in turn and watch the map. Any tile that is shown marked with a blue rectangle is a tile where you might reasonably expect to find some of that energy type. This publicly-available information is *very* general and often inaccurate (your own survey results are much more precise and useful), but it's better than nothing. Try to find an area where the deposits overlay indicates several different energy sources might be found. Then go back up to the **Overlays** menu and click on **Deposits & Surveys** again, to turn the overlay off.

Now you're ready to send out your survey teams. Look at the *current unit box*, just underneath the zoom map. You want it to be showing a pair of binoculars, telling you that your survey units are ready to be deployed. The *information bar* just below that should say **Survey**. If some other picture appears in the current unit box, look for the large golden letter e at the bottom of the control panel. Just above it is a box showing a pair of binoculars. Click on the binoculars, then check the current unit box again. The binoculars should now be showing in the current unit box.

Left click on the map in the location where you want your first survey team to begin. A **Site Permit Box** should appear. (If you click in a closed territory by mistake, you'll get a message from the UN instead.) This is a communication from the territory, asking you to pay a fee for a license to survey all the land in their territory. They will also tell you what the per-tile survey fee for each ter-



ritory will be. Click on **Yes**. You'll see a square tile with a pair of binoculars appear on the spot where you clicked. In the upper right corner of the binoculars tile is a tiny blue box, showing that this survey team is run by your corporation. The survey teams from the other companies will look exactly like yours, except for the color of the corporation box.

Click on a second location to place your second survey team. This time there won't be a panel, since you've already paid the fee. You can now survey as many tiles in that one territory as you like without paying a second license fee (though you still have to pay a small per-tile amount and your survey teams' wages.)

End Your First Turn

Survey results take three months to come in, and until they arrive there's not much else you can do (unless you want to start building blind, which isn't a grand idea.) Click on the button that says **End Month**, in the lower right corner of the screen. A **Financial Statistics Report** will appear, which shows you very little at this point; you'll see that your corporation lost a small amount of money in the last month due to licensing fees and survey team hiring costs. Since you haven't started producing energy, you have no income yet.

Click on **OK**. Next, a **Corporation Comparison Report** will appear. This shows you what types of energy each of the four companies are trying to develop, and what their current bank balances are. Since no one is developing anything yet, this report is also pretty boring right now. Click on **OK**.

At the end of your first turn, you'll notice that the other companies have started sending out survey teams, too. Get through two more months quickly by clicking on **End Month** and moving past the monthly reports twice. At the end of the third month, you should see two things happen: your survey teams will disappear from the main map, and the golden letter e on the control panel will start rotate. This means that you have electronic mail (E-mail) waiting for you. Your survey team's results always arrive via electronic mail. Click on the e to bring up the *Message List Screen*.

You should have two messages waiting, one from each of your survey teams. A small arrow next to message 001 indicates that it's the current message. Click on the button marked **View** to bring up the survey results.

View the Survey Results

The survey results are presented as a 3 x 3 grid of squares. Each square represents one of the tiles surveyed by that team, and shows the four energy types which are in greatest abundance in that square. (The four energy types are not displayed in any relevant order.) The survey results are *not* exact — they are approximations. A square may have less than four energy types, but no square has more than four.

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For the three fossil fuels (oil, gas, coal), the number shown can be up to 25,500 and represents the total available amount of that fuel that can be gotten from that site. Once the total fuel is extracted, the site will produce no more energy. For the non-fossil fuel sources, the number shown can be up to 85 (except for Nuclear power, which is sometimes higher), and represents the maximum amount of energy that location can provide *per month per operational rig at the site.* Although the possible numbers for the non-fossil fuels are lower than for fossil fuels, the non-fossil energy sources never run out.

The blue bar next to each energy source shows the *Ease* of extraction of that energy. The more blue in the bar, the greater the difficulty of extracting the energy. A high level of difficulty may mean that no energy can be obtained from that energy resource at that site at all until the available technology improves. The red bar indicates how much environmental damage will occur by developing that energy source. The more red, the worse the damage.

Examine the survey results and take note of high-level resource areas with low difficulty ratings. Click on Exit to return to the E-mail window, then use the down arrow on your keyboard to move to the next message and examine the second set of survey results. When finished, click Exit, and then click on Exit in the E-mail window to close it and return to the main screen.

Once you've read all the current mail, the e will stop turning. Your E-mail will stay in your box until you delete it. Hang onto your survey mail until you're sure you're done with it — although you can access the survey information in other ways (see the Game Manual), your survey results are a good way to keep track of this information.

The Basics of Extracting Energy

Now that you know where the energy is, you have to extract it. Turning resources into usable energy is simple for non-fossil fuel sources, and a little more complicated for fossil fuels. All *Non-Fossil Fuels* (nuclear, hydroelectric, solar, wind, geothermal, and tidal) produce energy directly; only the main collecting unit needs to be built in order for the energy (and the money) to start rolling in.

Coal and Gas, however, need to be transported to a *Generator* in order for the energy to be produced; after building either a coal mine or a natural gas well, you also have to build a generator to burn the coal or gas and produce energy. Coal and Gas are automatically transported to your generator, although you can arrange to transport Gas via pipeline if you wish.

Deposits of *Oil* require an additional step. The petroleum from your wells needs to first go to a *Refinery* for cracking, and then to a Generator to be burned for energy. As with Gas, Oil is automatically shipped to your generator.

unless you build a pipeline for it (which may or may not be more cost-effective.) Refineries and Generators can service more than one energy-producing unit, although they do have limits which are determined by how advanced they are technologically. Generators and Refineries should be as close to as many energy producing sites as possible — shipping costs increase the farther the resource has to be moved.

Based on the results of your surveys, you should decide on two types of energy production to specialize in, one non-fossil and one fossil fuel. This will allow you to concentrate your Technical Research on those types of energy production. (How to do Technical Research will be covered in a moment.) For this tutorial, you're going to specialize in Solar Energy and Coal Mining.

Build a Solar Farm

Click on the E-mail icon again, select one of your surveys, and bring up the survey results.

Find a square producing high levels of solar energy (greater than fifty, if possible.) Check to see that the square isn't more useful for some other type of energy you might want to exploit later, as you can only have one type of energy-extracting unit on a tile at a time. Move the mouse pointer to the small terrain grid at the lower right of the screen and click on the tile in the same position as that square. You will jump to the main display screen, and you will see your marker on the location of the square you just selected. Your marker follows you around as you act, always moving to the last location you were working on or examining.

In addition to bringing up each of your E-mail surveys, there's another way to find a good place to set up a solar farm. Go to the Overlays menu and select **Deposits and Surveys**. You will see the same light blue bars you saw earlier. Select one of the nine energy unit building icons (just below the **Current Unit Information Bar**. Any light blue bars is areas you've surveyed (which are not occupied by units from other corporations) will display numbers indicating the yield of the energy type you've currently selected. Beneath the light blue bars will be small versions of the red environmental damage bars and the dark blue ease of access bars for that energy type. Using this map, you can see which squares of the ones you have surveyed have the greatest potential for solar energy.

Locate the picture of the sun on the control panel and click on it. The current icon box will change to show the sun, and the information box will start cycling through information: first, the name of the unit (**Solar**), then the cost to build one solar farm, then the cost to maintain it (per month), and the cost to run it (per month.)

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Left click on the site where your marker is. An **Extraction Permit Box** will appear, offering you a deal. The territory will allow you to extract the natural resource you want from that tile for a certain set fee plus (usually) a royalty — a part of your profits to be paid directly to the territory itself. This information is displayed on the right half of the box. On the left half of the box is the summary of the amount of energy, the ease rating, and the expected amount of environmental damage that will occur if that type of site is built at that location. Click on **Yes** to close the deal and your solar plant will appear, looking like a bank of glass mirrors. It will begin producing energy in the following month.

Right click on the picture of the solar farm to get a panel summary of information on this particular unit. On the left half of the panel is a display that should read **1 Parabolic Dish**. This indicates that you have one *rig* at the site, and its Technological level is *Parabolic Dish*, the lowest possible. At the right edge of this display is a small arrow; click on it to bring up the **Technology Department** panel. From this panel, you can increase the number of rigs at the site (up to a maximum of ten), and upgrade older rigs once new technology becomes available. In the center of the panel is a pair of up and down arrows. Next to the arrows is the dollar amount it will cost you to add each new rig. Click on the up arrow until you have added the maximum number of rigs to the site, then click on **OK** to return to the main screen.

Get a Bank Loan

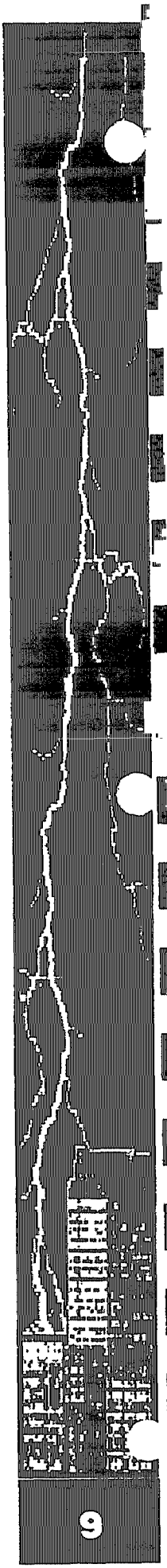
Improving your Solar Plant will probably drain your available cash to almost nothing. To get more working capital, you need to take out a *Bank Loan*.

Go to the **Departments** Menu and select **Bank Liaison**. The **World Bank** panel appears. Loans are handled in the lower left corner of the panel. Click on the white box next to the words **Loan Amount**. A line cursor will appear in the box. Type in *500* (the amount of the loan you want), and press *Enter*. The loan will be granted automatically, provided you don't try to exceed your personal loan limit. The money from the loan will be automatically added to your corporation's funds. Click **OK** to return to the main screen.

Build a Coal Mine

Now, you need to locate a spot that's good for coal mining. You can do this either by calling up your E-mail surveys again or you can right click on any tile that you have already surveyed to get a display of the survey results.

Find a spot that has a good deposit of coal (15,000 or better, if possible), and that has a low difficulty factor. Select the picture of the lump of coal on the control panel so that it becomes the current unit, and left click on the tile where you want to build the mine. As with the solar plant, a panel will appear offering you the territory's terms under which they will let you build. Click on



Yes, and your coal plant will appear. Following the same procedure as you did with the Solar Plant, add two or three more **Surface Cut** rigs to your coal plant. Don't use up all your money improving your coal mine — you need to save enough to build a Generator.

Next, find another site near to your coal plant which has little in the way of usable energy resources and which is not on a river. Find the Generator picture (it looks like a factory with a lot of smoke stacks), and click on the Generator to make it the current unit. Left click on the site you've selected to build your generator. Without the generator, it wouldn't matter how much coal you had — you'd get no energy from it. The coal from the mine will automatically be shipped to the Generator and burned to produce electricity.

Do Research

To be able to make more efficient use of renewable non-fossil resources, and to be able to get to deeply buried deposits of fossil fuels, you will need to do research into energy technology.

On the menu bar, click on **Departments**, then on **R & D**. The **Research and Development Department** panel appears. At the top right of the panel are the words **Hire/Fire Scientists** and a pair of up and down arrows. Click on the up arrow four times to hire four teams of scientists for your labs.

Next, click on the picture of the lump of coal. The **Research Assignment** panel appears. It shows you what your current level of technology for coal mining is, what the next level you can achieve is, and what benefits you'll get from that advancement. Next to the word **Assigned** is another pair of up and down arrows. Click on the up arrow twice to assign two teams of scientists to doing research on coal mining technology, then click on **OK**. Back at the main R&D panel, click on the picture of the sun and assign the other two scientific teams you hired to do research into solar energy technology. When you finish, click on OK to return to the main screen.

Click on **End Month**. Now that you have two sites built, an additional report will be added to the month's end display — the **Map of Developed Extraction Sites**. A black square will appear everywhere you have built a site. At the end of the first month after you build your first two sites, you'll notice that they both flash yellow. This indicates that they produced no energy last month. This is normal — all sites take at least one month, often longer, to start producing energy. A site that suddenly stops producing energy, however, is a site that's in trouble and needs attention.

Continue Your Game

From this point, you need to continue doing what you have been: surveying new territory and building new energy-producing sites. You will see your com-

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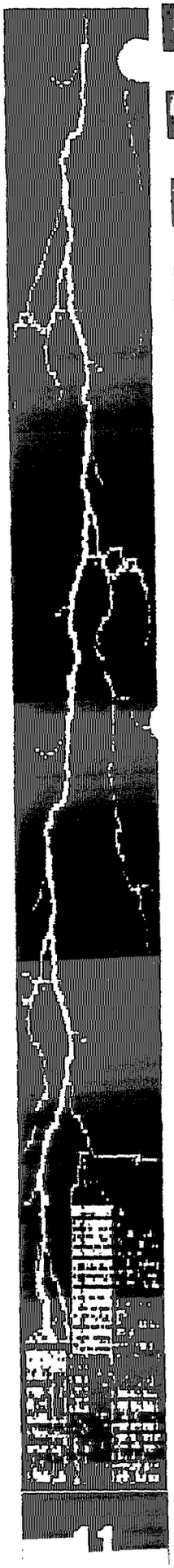
Remember

petition doing the same thing, taking up sites and preventing you from developing them. Eventually, your scientists will come up with some new technology and inform you by E-mail; at that point, if you can afford it, you'll want to start upgrading your machinery.

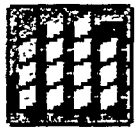
Before too long, the energy needs of the first territory should be at least 75% satisfied, at which time the UN will authorize the opening of a second territory adjoining the first. When that happens, you'll want to move into the new territory and start developing it as well. As more time progresses, you'll have to start paying attention to such issues as the safety of your sites, and the long-term environmental damage they are causing. For details on how to deal with these and other aspects of the game, please read the PowerHouse Game Manual.

Remember — the power is in your hands!



Energy Extraction Sites

Nuclear


Solar

Wind, offshore

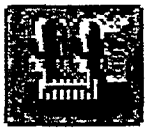
Wind, onshore

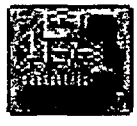
Oil, offshore

Oil, onshore

Gas, offshore

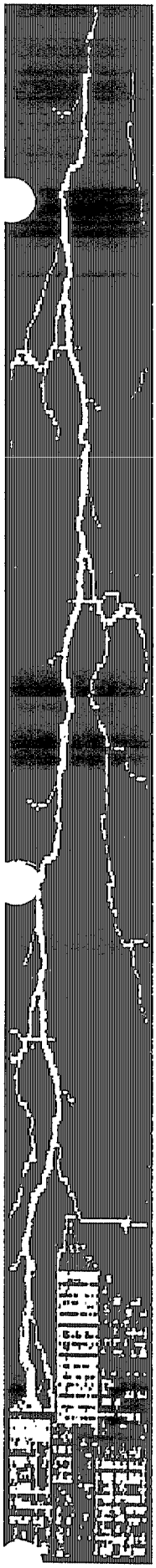
Gas, onshore


Geothermal


Coal

Hydroelectric

Tidal/Wave



Energy Sources

Oil

Hydroelectric

Natural Gas

Solar

Coal

Wind

Nuclear

Geothermal

Tidal

Control Panel Icons

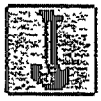
Pipe

Transformer

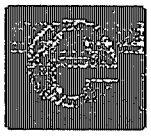
Refinery

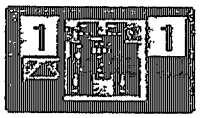
Close site

Generator


Clean up site

Capacitor


E-mail



Survey teams

Reports and Other Icons

Bank

Stock market

Profit & loss report

Income report

Outgoings report

Deposits map

Energy needs

Performance report

Completed surveys

Production and demand

Research & development

Territory status map

Map of developed extraction sites

Annual turnover

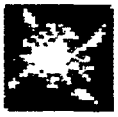
Annual profit

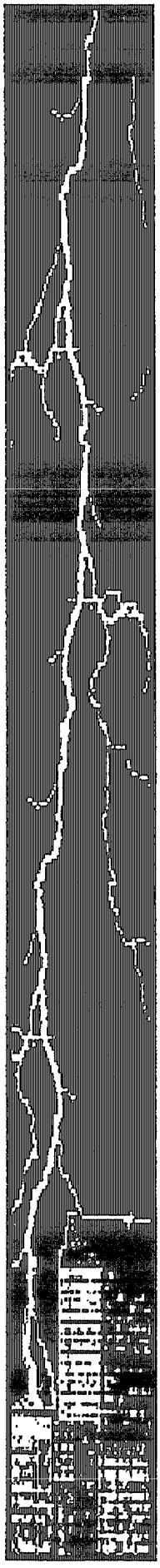
Year-to-date turnover

Environmental damage

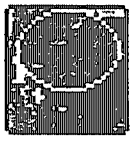
Energy turnover: the world

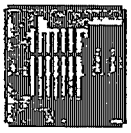
Energy turnover: you


Most dangerous sites



Utility Sites


Refinery


Transformer

Generator

Capacitor

Map buttons

Magnify

Map Overlays

Marker

Borders

February 16, 1998

Module I

Industrial Assessment Center

Industrial Assessment Center
(formerly the Energy Analysis and Diagnostic Center) Program

- Concept:

  The federal government supports universities to provide consulting services to regional industry in the areas of energy efficiency, waste minimization and productivity enhancement.

- Program Structure:

  - The U.S. DOE provides program funding (≈$8 million/yr). There is no direct cost to participating industrial plants.

  - 30 participating U.S. universities are overseen by two field management agencies.

  - Each University Center serves 30 small-to-medium-sized clients within a 150 mile radius of campus per year.

  - Project activities include a one-day in-plant assessment and the preparation of an assessment report for submission to each participating client.

  - Center employs both undergraduate and graduate full-time engineering students as technical assistants.

- Program Benefits:

  - Industrial clients receive a quality study with recommendations for specific actions to reduce energy use and waste generation and to improve productivity.

  - Participating students:

    - Receive practical training in industrial technologies and energy auditing techniques.

    - Receive salary funds to assist in personal costs of educational program of study.

  - Engineering faculty and staff engineers are exposed to actual industrial work settings which:

    - Improves the industrial relevance of classroom instruction.

        - Serves to aid in the identification of relevant industrial research needs.

    - The sponsoring government agency achieves conservation of national resources and improvement of industrial productivity.

- History:

    - Program has operated continuously since 1976.

    - Over 5,000 industrial assessments have been performed by all centers since program inception.

    - Over 1,000 students have been employed in the program over a twenty-year period.

- Project Staffing:

    - Engineering faculty members or professional staff engineers participate as assessment team leaders.

    - Several students work in team format during in-plant data gathering and in the drafting of technical reports.

- Program Activities:

    - Student Staffing:

        - Exceptional students are invited to accept a project position.

        - Notices of position openings are posted and interested students are interviewed before ranking and hiring.

        - The University of Tennessee IAC employees from 3 to 8 students at any time.

    - Student Training for Project Work:

        - Completion of specific engineering coursework is not required but students must be enrolled in an engineering program of academic study.

        - Students learn project procedures by working in teams during assessments as apprentices to more experienced students.

- Facilities for Project Work:
    - A university office equipped with desks, desktop computers and hardcopy files, telephones.
- Overall Procedure for Completion of Assessments:
    - Prospective industrial clients are identified from published listings of regional manufacturers.
    - Plants are contacted by telephone by student assistants to solicit program participation.
    - Qualifying plants accepting the offer of an assessment are scheduled for a plant visit.
    - The team drives in an automobile to the plant to be assessed (up to 4 hour drive one-way).
- In-plant activities:
    - Interview with plant staff members.
    - Completion of data questionnaires.
    - Inspection of actual plant processes.
- Selected measurement are made on energy-using systems:
    - Boiler stack gas analysis.
    - Process equipment surface and air temperatures.
    - Lighting levels.
    - Electrical equipment power use (in cases where plant electrician can access cabling).
    - Air flowrates.
- Return to university.
- Student teams prepare a draft report for iterative internal review and finalization before mailing to client (within two months of the plant visit date).

- Post-Assessment Evaluation:

    - Within one year after submission of the assessment report the client is contacted by telephone to collect data on the implementation of recommendations made in the client's report. Typical measure implementation rate is 50%.

- Maintenance of Program Quality:

    - Field manager must approve individuals serving as professional team leaders.

    - Copies of all assessment reports are provided to the program field managers. Selected reports are critiqued.

    - Requirement to collect and report recommendation implementation data to field manager.

    - Field management organization staff periodically accompany assessment teams in the field.

    - DOE and field managers join all Center Directors in a annual "Director's Meeting" to share program results and to discuss administrative matters.

    - Field managers submit annual reports of program results to DOE.

Identification and Prioritization of Energy Efficiency Improvements

1. Types of Measures

   - Procedural changes (e.g., shut down idling equipment)
   - Retrofit with high efficiency components (e.g., drive motors)
   - New high efficiency systems (e.g., chilled water system)
   - Improved controls (e.g., building energy management systems)

2. Sources for identifying measures

   - Government-sponsored resource databases
   - Technical and professional literature (e.g., Energy Users News)
   - Vendor literature
   - General checklists
   - Outreach service organizations (e.g., The University of Tennessee Center for Industrial Services)

3. Bases for Selecting Measures

   - High level of projected energy and cost savings
   - Capital is available
   - Rapid recovery (payback) of investment
   - Simple procedures for implementation

Energy Conservation Measure Checklist

Process Energy

1. Shut off equipment during periods of non-production

2. Improve operating efficiency of combustion equipment
   a) Purchase and utilize new energy-efficient equipment
   b) Replace burner(s) with high combustion efficiency burners
   c) Adjust gas/oil burners for efficient combustion
   d) Adjust air/fuel ratio
   e) Repair fuel leaks
   f) Add insulation to heated surfaces
   g) Recover heat from stack gases
   h) Lower control temperature for heated medium

3. Improve transfer efficiency of mechanical drives
   a) Lubricate/improve maintenance to reduce frictional losses
   b) Replace standard V-belts with cogged V-belts

4. Reduce heat losses from system components (e.g., fluid-holding tanks, heated extruder barrels)
   a) Add insulation to hot/cold surfaces

5. Improve efficiency of electric motor drives
   a) Replace standard motors with high efficiency units
   b) Replace oversized motors with downsized units
   c) Install variable speed drive controls

Plant Utilities

1. Electricity
   a) Install cogeneration system
   b) Install demand control computer
   c) Install a demand peak-shaving generator
   d) Correct power factor
   e) Increase distribution system supply voltage

2. Steam systems
   a) Boilers
      i) Shut down boiler(s) during periods of non-use of steam or hot water
      ii) Valve off unused boilers.
      iii) Reduce steam pressure set point
      iv) Replace inefficient burner

v) Adjust burner for efficient combustion
vi) Adjust air/fuel ratio
vii) Clean boiler tubes
viii) Install stack gas heat recovery (economizer) unit
ix) Install blowdown heat recovery system
x) Install turbulators in boiler fire-tubes
xi) Install combustion air preheater
xii) Install make-up water preheater

b) Steam and condensate distribution systems
i) Insulate steam lines and valve bodies
ii) Repair steam leaks
iii) Return condensate to boiler
iv) Repair leaking steam traps

3. Compressed air system
a) Compressors
i) Install high energy efficiency unit(s)
ii) Clean intake air filter(s)
iii) Duct cool outside air to compressor(s) intakes
iv) Reduce output pressure set point
v) Stage loading of multiple compressors
vi) Replace hydrocarbon with synthetic lubricant
vii) Duct compressor waste heat to building interior to supplement space heating

b) Compressed air distribution and use
i) Increase distribution pipe diameter or add parallel lines and reduce line pressure
ii) Repair leaks
iii) Install solenoid valve shut off of air supply to equipment when unneeded
iv) Replace air blow off with fan air or mechanical action

4. Chiller systems
a) Shut down idling units
b) Stage operation of multiple units
c) Insulate chilled water lines
d) Increase circulating chilled water temperature
e) Clean cooling tower water and heat transfer surfaces
f) Install chiller variable speed control
g) Turn off cooling tower fans during light load conditions
h) Duty cycle chilled water pumps

Lighting Systems

1. Delamp or turn off lights in unused areas
2. Install more energy efficient lighting fixtures or sources (e.g., high-efficiency fluorescent tubes, high intensity discharge lighting systems)
3. Install mirror reflectors and delamp fluorescent fixtures
4. Lower fixtures and delamp
5. Clean fixtures and delamp
6. Install in-roof skylights and delamp

Space Heating and Cooling

1. Heating and cooling systems
   a) Discontinue space conditioning of unused plant areas
   b) Setback thermostats during unoccupied periods
   c) Install more efficient central heating and cooling systems
   d) Reduce make-up air flow rates
   e) Utilize outside air (economizer cycle) for interior conditioning
   f) Install destratification fans

2. Building envelope
   a) Add insulation roof and/or walls
   b) Weatherstrip doors and window
   c) Install storm windows or double-glazed glass
   d) Apply reflective film or paint to roof surface
   e) Install water-spray roof cooling system
   f) Install a vestibule at building entranceway

Miscellaneous Systems

1. Timer off vending machines during building unoccupied periods

February 16, 1998

Module II

Stakeholder Relations Carlesbad Highlands

Bank of America and the Carlsbad Highlands Foreclosure (A)

by

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Bank of America and the Carlsbad Highlands Foreclosure (A)

Jim Jackson opened the file lying on his desk marked "Carlsbad Highlands." Recently appointed to the position of Vice President, Corporate Real Estate, in Bank of America's Costa Mesa office in Orange County, California, Jackson had the job--as he somewhat delicately put it--of converting bad loans into assets. Bank of America (B of A) was in the business of loaning money, not in the business of marketing real estate. But, when a developer was unable, for whatever reason, to meet payments on a loan, the bank often acquired the property in foreclosure. It was Jackson's job to find the best price he could for these properties, if possible preventing the bank from taking a loss on the loan. His job was to sell real estate--much of it unimproved or partially improved land where a developer's project had somehow gone bad.

The Carlsbad Highlands property did not look promising. The upper left-hand corner was stamped "IN FORECLOSURE." He quickly skimmed the case file and appraiser's report forwarded to him by the bank's loan department. The story was plain enough, if

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By Anne T. Lawrence, College of Business, San Jose State University, San Jose, CA 95192-0070. Originally presented at the annual meeting of the Western Casewriters Association, March 1996. Research was supported in part by the San Jose State University College of Business. This case was written with the cooperation of the Bank of America and its officers and of federal, state, and regulatory agencies, solely for the purpose of stimulating student discussion. All persons and events are real. Copyright by the author, 1996.

painful in its details. The 263-acre property in the foothills north of San Diego had been acquired by a developer in the mid-1980s with a five percent downpayment and a $6.8 million loan from B of A. At the time of acquisition, the property had been approved for 740 single-family homes. The developer had been preparing to begin construction when, in 1989, the bubble burst in the Southern California housing market, lowering the probable market value of the homes.

Compounding the developer's problems, the City of Carlsbad, where the parcel was located, had imposed a requirement that the developer construct a two-mile extension to an existing road, Cannon Road. The developer had planned to share the construction costs with neighboring developments, but these had not proceeded as anticipated, leaving the entire roadbuilding cost on his shoulders.

But the final blow to the project had been not the market downturn or infrastructure requirements, but an environmental problem. In March, 1993, the U.S. Fish and Wildlife Service (USFWS) listed the California gnatcatcher--a small, grayish bird with a call like a kitten's meow--as a "threatened" species under the Endangered Species Act of 1973. The gnatcatcher lived exclusively in the coastal sage scrub ecosystem--a mixture of sagebrush, cactus, and buckwheat that used to dominate much of coastal southern California. Under the pressure of relentless development, coastal sage scrub had dwindled to less than 400,000 fragmented acres between Los Angeles and the Mexican border. The USFWS, under law, had authority to block development that

encroached on gnatcatcher habitat. Unhappily for its would-be developer, Carlsbad Highlands was about 40 percent coastal sage scrub--and, moreover, connected two other parcels of prime gnatcatcher habitat, thus forming an ecologically significant corridor. Since the development plan had been approved ten years earlier, it had not been designed to be sensitive to gnatcatcher habitat. Now, the U.S. Fish and Wildlife Service would surely not approve the necessary grading.

In July, 1993, just two months after the gnatcatcher listing, the beleaguered developer had finally thrown in the towel on the project and walked away from the loan, and the bank was left holding the property.

Now, just days later, Jackson's eye scanned down the appraiser's report to the bottom line: APPRAISED VALUE: $112,000. One hundred and twelve thousand dollars on a loan of almost seven million dollars! A native of San Diego, Jackson had had many years of experience as a land developer before coming to the bank, and he was all too familiar with the ups--and, more recently, downs--of the California land market. But the figures on Carlsbad Highlands were shocking even to his experienced eyes.

Within a few minutes, Jackson found himself in the car, driving south along the Pacific on Route 5, then turning up into the hills above the coastal city of Carlsbad. His route took him by several recent housing developments of the type planned for Carlsbad Highlands--compact communities of expensive, white stucco homes with red tile roofs, in the Mediterranean style favored by 1990s California homebuyers.

About five miles up, Jackson got out of his car and started hiking across the property. Much of the land was covered with unprepossessing, low-lying khaki-colored scrub--the kind preferred by the gnatcatcher, although Jackson could not see or hear any birds. Examining the land carefully as he walked, Jackson could see the remnants of an old irrigation system, installed by an earlier owner who had used part of the property for farming tomatoes. Up ahead, the land had been torn up by dirt bikers, who had left broken vegetation and tire marks in their wake. To the east, the property line was marked by new subdivision housing, lying just over the border in the City of Oceanside. Their utilities could be extended, Jackson thought, if the cities would sign an agreement. To the west, the designated source of utilities, there was no development for a mile or more. Below and some five miles to the west, Pacific ocean swells broke against the shore.

"If I had $112,000 in my pocket, I'd buy this property myself," Jackson mused to himself as he walked back to his car. "This property has got to be worth more than that, even if all you wanted to do with it was build a single ranch house and keep some horses up here. The view alone is worth that much."

Bank of America's Environmental Strategy

Bank of America, the reluctant owner of the Carlsbad Highlands property, was unusual in the financial services industry in its commitment to corporate social responsibility as

well as its sensitivity to environmental issues. Founded in 1904 in San Francisco by A.G. Giannini, the Bank of Italy--as B of A was then known--was committed to serving the unmet banking needs of California's immigrants and working classes. Throughout its history, the bank had tended to seek out unconventional opportunities for growth. Richard M. Rosenberg, who became chairman and CEO in 1989, characterized the bank's philosophy as the belief that "conventional wisdom is just that--predictable at best...not very interesting...and frequently wrong." The most effective strategy, he stated, was one that met "the rising expectations among our larger universe of stakeholders who believe that business should actively address the social challenges of our time."[1]

In March, 1990, Rosenberg formed an environmental task force, comprised of 30 top officers, charged with developing an environmental strategy. In part, this initiative reflected the new CEO's own values. A committed environmentalist, Rosenberg had met with representatives of the Environmental Defense Fund shortly before taking office to share ideas about the bank's environmental stewardship. In part, it reflected the bank's officers' perception of heightened stakeholder activism. The Exxon Valdez oil spill in 1989 had caused a public outcry, and shareholder activists had called on businesses to adopt a voluntary code of environmental responsibility, later known as the CERES (Coalition for Environmentally Responsible Economies) Principles. In late 1989, the Corporate Secretary had warned the CEO that the bank could become the target of a shareholder proxy

election campaign, focused on environmental issues. Now, preparations for the 20th anniversary of Earth Day in April, 1990, had once more cast a spotlight on "green" concerns.

Bank executives clearly also saw environmentalism as an opportunity for competitive advantage. Since the mid-1980s, courts had held lending institutions liable for environmentally contaminated property, increasing credit risk. In the late 1980s, B of A had begun systematic environmental risk assessment before approving credit applications. The bank had established and staffed an Environmental Services Department, charged with assessing possible environmental liabilities of assets or real estate pledged as collateral against proposed loans. The active work of this group had succeeded in reducing the number of loans with environmental problems.

Rosenberg's environmental task force, working with a consultant--SRI International--produced a set of nine principles. These principles (Figure 1) were approved by the Board of Directors in December, 1990, making Bank of America the first major U.S. financial institution to adopt an explicit policy on environmental issues. To implement these principles, the bank established a full-time unit, the Department of Environmental Policies and Programs (DEPP), headed by senior vice president Richard Morrison, a well-respected officer with 25 years of line experience. To support the work of the unit, the bank created a 14-person environmental "team" consisting of top bank officials who remained in their functional and geographic organizations, where they were responsible for implementation. "Environ-

mentalism at Bank of America is not a central staff function," Morrison commented. "It is the responsibility of the major line and staff departments."[2]

-- Figure 1 about here --

The Department immediately set about operationalizing the nine principles. Its first efforts, in Morrison's words, were "getting our own act together." The bank initiated internal programs to reduce consumption; recycle paper, plastic, and metals; and conserve water. Morrison's department staff worked with purchasing to buy recycled products where possible. They also worked with the Environmental Services Department to broaden pre-loan assessments to examine environmental benefits as well as costs. As Morrison put it, the objective was to "try harder to make an environmentally beneficial deal bankable [as well as] deny... credit to borrowers who show a blatant disregard for the environment."[3]

By its third year of operation--1993--Morrison's department had formulated four goals (Appendix A). On the first three--minimize environmental impact, enhance employee and public awareness, and clean air and water--the bank had already made significant progress. The fourth goal, however, represented a new challenge:

> Goal 4: Encourage activity that respects preservation of natural habitats and biological diversity

The bank had begun to address this goal in its loans to companies

Figure 1

Bank of America's Environmental Principles

BankAmerica pledges to conduct business in a manner consistent with the following environmental principles:

1 BankAmerica will follow responsible environmental practices in all of its operations and places of business.

2 BankAmerica will make the environmental responsibility displayed by customers and suppliers a factor in all relevant business decisions.

3 BankAmerica will solicit advice and technical expertise in the development and management of its environmental programs and practices.

4 BankAmerica will make a special effort to identify businesses and organizations that are attempting to find solutions to environmental problems and provide appropriate support.

5 BankAmerica will provide employees and retirees with information regarding environmental issues in order to help them make informed decisions.

6 BankAmerica will expand its recycling, energy and waste management programs.

7 BankAmerica will recognize and reward employees for actions that support these principles.

8 BankAmerica will periodically assess its performance in identifying and addressing environmental issues.

9 BankAmerica is committed to improving the understanding of the full social impact of government and business actions that affect the environment and the economy.

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in the forest products industry of the Pacific Northwest, where it had worked with a consultant to evaluate whether or not a company's practices were consistent with sustainable harvesting. Beyond this, however, Morrison's department had made little progress in operationalizing the fourth goal.

By the time the Carlsbad Highlands foreclosure landed on Jim Jackson's desk, the Bank of America had clearly established itself as the leading environmental activist among U.S. banks and had established a goal, in principle, of promoting habitat protection and biodiversity. Few people in the bank, however, had given much thought to how this lofty aim would be implemented, or what it might mean to troops in the field like Jackson.

The Endangered Species Act and Property Rights

The Endangered Species Act (ESA)--under which the California gnatcatcher had been listed--was passed by Congress in 1973 to conserve species of fish and wildlife threatened with extinction and the habitats on which they depended. Under the law, the Department of the Interior (through its subdivision, the USFWS) was required to make a list of threatened and endangered species, to designate critical habitat, and to devise plans for the species' recovery. Under the law's "taking" provision, it was illegal to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" a threatened or endangered species, or "to attempt to engage in any such conduct." The term "taking" was interpreted to include modifying habitat in a way that would

injure or harm a protected species. Violations of the law were subject to both civil and criminal penalties.

Two provisions of the Act gave the Department of the Interior broad powers to conserve land. The first, the "jeopardy clause," stated that federal agencies could not authorize, fund, or carry out any actions that would jeopardize an endangered or threatened species or modify critical habitat. In effect, this clause gave Interior power not only to limit the uses of public lands such as national forests, but also to cut off federal funding for projects, such as roads, dams, or military contracts, that would modify habitat. In an important decision, the Supreme Court in 1978 blocked completion of the Tellico Dam (a Tennessee Valley Authority project) because it would flood a portion of the Little Tennessee River, the last remaining habitat of an endangered fish called the snail darter. The court ruled that the intent of the Endangered Species Act had been "to halt and reverse the trend toward species extinction, whatever the cost," and that the law did not include any mechanism for weighing the relative value of a particular species--in this case, the snail darter--against that of economic development--the dam. (Tellico was later completed, after Congress passed a special exemption for the project.)

But the law had important significance for private landowners, as well. The "taking" provision of the law was generally interpreted by Interior and by the courts as preventing private property owners from modifying their own land, if doing so would degrade habitat and disrupt important behavior patterns,

such as nest-building. The law often had the effect, therefore, of reducing the market value of land that included endangered species' habitat. Property owners with a sensitive species on their land had a perverse incentive to destroy habitat--or even to kill the species--before it was listed, so that the owner's use of the property would not be impaired. In the words of David Howard, an officer of a property rights group known as the Alliance for America, many landowners had come to the conclusion that "the answer is often SSS--short for 'shoot, shovel, and shut up.'"[4]

During the 1970s and 1980s, various mechanisms had evolved in other environmental protection laws to accommodate private landowners with impacted property. Most common was the practice of case-by-case mitigation. For example, under the Clean Water Act, development of wetlands was strictly controlled. But landowners could apply for "dredge-and-fill" permits. These were often granted, subject to the landowner's agreement to mitigate the impact--for example, by leaving some of the wetlands undeveloped, buying and setting aside wetlands somewhere else, or paying a fee to support conservation efforts.

Not all affected stakeholders, however, were happy with this solution. Environmentalists were concerned that case-by-case mitigation tended to produce small, fragmented parcels of habitat, where species would be vulnerable to predators and isolated from others of their kind. They preferred larger, contiguous preserves, inhabited by larger populations, that could be actively managed. For their part, developers were aggravated

by delays, uncertainty, and contradictory rulings by different regulatory authorities. In some cases, developers were actually required to purchase property for mitigation--land they otherwise had no interest in owning. The system also burdened regulators, who confronted a stream of discrete permit requests without an overall plan to guide individual decisions.

In 1982, Congress amended the Endangered Species Act to address the emerging conflict between habitat conservation and land development. Section 10 established a new mechanism, the habitat conservation plan, or HCP. An HCP was intended to be a comprehensive, regional plan to conserve habitat for one or more listed species, negotiated in a collaborative process by a range of affected stakeholders, including developers, environmentalists, and regulators. If the U.S. Fish and Wildlife Service approved an HCP, the agency could issue an "incidental taking permit," allowing some development to proceed in an endangered species' habitat if part of a pre-approved, area-wide conservation plan. HCP's were praised for "adding flexibility...and promoting compromise and negotiated settlements between the development and environmental communities."[5] HCPs were also superior to the case-by-case mitigation used in wetlands regulation because they allowed, in principle at least, for regional conservation planning.

Despite their apparent advantages, few HCPs were negotiated during the 1980s. One successful application of the HCP process occurred near San Francisco, where landowners seeking to build on San Bruno Mountain--home to the federally-listed mission blue

butterfly--were able to negotiate with regulators a plan that allowed some development to proceed, while setting aside large sections of the property for butterfly habitat. Two other HCP's were approved in the 1980s, both also in California. Other habitat planning efforts were initiated, all in regions of the country that had both endangered species and strong real estate markets. In the "hill country" west of Austin, Texas; in the wetlands near Disney World in Orlando, Florida; and in the pine barrens of southeastern New Jersey, for example, stakeholders attempted to negotiate regional conservation plans. By 1992, however, none of these efforts had yet reached a successful conclusion. Some observers cited a lack of funding for habitat acquisition. Others pointed to a lack of support from the Reagan and Bush administrations, which some said "seemed to encourage conflicts as a means for building support from property owners, timber companies, and farmers to weaken the (endangered species) act."[6]

The Clinton administration, by contrast, moved aggressively to promote the habitat conservation plan model. In April, 1993, barely three months after taking office, President Clinton convened a well-publicized "forest conference" in Portland, Oregon, at which he attempted to bring together adversaries in the long-simmering controversy over the spotted owl to negotiate what was, in effect, a habitat conservation plan. Two weeks later, Clinton's Secretary of the Interior, Bruce Babbitt, seemed to signal the Administration's intentions when he announced that the government had negotiated a plan with Georgia Pacific

Corporation. The timber company had agreed to restrict logging on about 50,000 acres inhabited by the protected red-cockaded woodpecker; in exchange, the government had pledged not to use the ESA to curtail logging elsewhere on the company's timberlands in the southeastern states. This kind of negotiated settlement, Babbitt told the press, was the only way to avoid "the environmental and economic train wrecks we've seen in the past decade."[7]

Development and Conservation Planning in San Diego County

San Diego County, the site of Jim Jackson's problem, had all the ingredients of such a "train wreck." During the 1980s, the California population grew from 24 million to 30 million--a growth rate of 25 percent, among the highest in the industrial world. Half the state's people lived in the corridor from Los Angeles south to the Mexican border. San Diego County itself had grown by 35 percent during this decade, adding 647,300 residents. More people created tremendous pressure for the conversion of open land. During the 1980s, the amount of developed land (housing, commercial, and industrial) in the urbanized coastal cordon, where most people lived, increased by 24 percent.

The San Diego region was also unusually rich in natural biological diversity, with many species pushed to the brink by relentless development. Its wide variety of topography, climate, and soils had created many unique habitats, including beaches and dunes, coastal sage scrub, oak woodlands, montane coniferous forest, and desert. By the early 1990s, the USFWS had listed

over 70 species in southern California (including 24 in the San Diego region) as threatened or endangered, and was considering adding over 300 more. In fact, a representative of the Nature Conservancy, writing in the early 1990s, called California the "epicenter of extinction in the continental United States."[8] Among the better known listed species in the San Diego area were the California gnatcatcher, the brown pelican, the golden eagle, and the mountain lion.

In 1991, California Governor Pete Wilson--a former mayor of San Diego who was familiar with the problems faced by developers there--had proposed a Natural Communities Conservation Program (NCCP) for the state. Intended as a kind of state version of the HCP, the NCCP aimed to develop habitat conservation plans that would simultaneously satisfy both the state's Department of Fish and Game (responsible for enforcing the state's own endangered species laws) and the USFWS. San Diego County's coastal scrub sage ecosystem was selected as the first pilot program.

Under the auspices of the NCCP, San Diego in 1991 initiated a multi-tiered regional planning process. The overall effort was directed by the San Diego Association of Governments (SANDAG), a regional agency. SANDAG began development of a comprehensive, regional multiple-species conservation plan and, subsumed under it, three sub-regional plans. One of these, the North County Multiple Habitat Conservation Program (MHCP), included the city of Carlsbad and the Carlsbad Highlands property. City of Carlsbad officials, like some other local jurisdictions, were also developing their own proposal, to be incorporated into the

larger plans. The goal of this complex, multi-layered process was to develop a habitat conservation plan for the entire region that would successfully balance economic and environmental objectives. Proponents hoped, moreover, that the effort would facilitate development by removing regulatory uncertainty and minimizing the likelihood of future endangered species listings.

The San Diego effort, not surprisingly, attracted Secretary Babbitt's attention as a potential model for the rest of the nation. In an interview in Rolling Stone in July, 1993, Babbitt said of the NCCP:

> This experiment...is breathtaking in its magnitude... The question is, can we invoke the land-use planning power of local communities, the enforcement power of the Endangered Species Act, and the framework of the state government to pull this off?...I think it's going to work.[9]

By the summer of 1993, however, this "breathtaking experiment" was still in its early stages. In the northern part of San Diego County, the working group was still busy trying to inventory biological resources and to draft a map of a workable system of preserves, consisting of parcels of high quality habitat and connecting corridors. There was still no good mechanism for paying for the preserves, and the plan was several years away from federal and state regulatory approval.

Considering the Options

Over the next few days, Jackson began sketching out the bank's options for the Carlsbad Highlands property. The appraiser had been legally required to report a value on the land's "highest and best" use, which the appraiser judged to be

speculation. Considering that the property's use for home development was compromised by the endangered species listing, the appraiser had assigned a rock-bottom estimate. The appraiser was probably right, Jackson thought, that the likelihood that the property would be approved for a big housing development any time soon was slim. However, a speculator might be willing to assume that risk or to buy at a low price and hold the land until it could be developed.

Considerable political uncertainty surrounded the Endangered Species Act and its enforcement. Clinton's Interior Secretary strongly supported the ESA and the concept of habitat conservation planning, and the federal courts had generally supported this position. However, some property rights groups had clamored for repeal or revision of the Act, and they had the ear of important Republicans in Congress. A political shift in Washington could change the risk equation significantly.

The land must have some conservation value, Jackson thought. But who would buy it? Was there a market for gnatcatcher habitat? Investigating further, Jackson learned that the 109 acres to the north of the property had been purchased within the past year by a developer as mitigation property. The buyer had paid a little over $1.4 million. However, this parcel had contained high quality coastal sage scrub and several documented pairs of nesting California gnatcatchers. A survey of the Carlsbad Highlands property had turned up only one pair of birds. Jackson's property probably was not worth as much, even if he could find a willing buyer.

Working the phones, Jackson learned that Caltrans, the California state transportation agency, was building a freeway in the City of Oceanside, a project that impacted coastal sage scrub. The USFWS had required that the agency buy 83 acres of coastal scrub elsewhere as mitigation, under the terms of a permit Caltrans had negotiated. Jackson soon had Caltrans on the phone. He described the property in detail. Were they interested? The Caltrans officer sounded discouraged. The agency was actively shopping for coastal sage scrub for mitigation, but the USFWS was very particular about what was acceptable and what was not. "Of course we're interested. But I doubt the feds would approve the Carlsbad Highlands property," the official responded glumly. "It doesn't have enough birds."

Agricultural development was a final possibility. The property had most recently been used for farming tomatoes, and Jackson had observed a rudimentary irrigation system in place that could be repaired and brought back into service. A farmer might be willing to pay up to $8,000 an acre, Jackson figured. His initial inquiries generated some promising leads. Within a few weeks, one farmer had made a formal offer of $1 million for the property, contingent on obtaining a permit to build a ranch house. The City of Carlsbad seemed favorable, since sale to a farmer would provide an intermediate use for the property until housing development would again become feasible. Without housing on the property, the City would never be able to afford improvements to Cannon Road. The farmer's offer was the best one

on the table, Jackson thought. Perhaps the bank ought to accept it.

Appendix A

Bank of America's Environmental Goals

Goal 1: Help generate sustainable economic prosperity with minimum adverse impact on the environment.

Goal 2: Enhance awareness among employees, customers, and the public about environmental issues.

Goal 3: Encourage economic activity that upholds high standards for clean air and water.

Goal 4: Encourage economic activity that respects preservation of natural habitats and biological diversity.

Notes

[1]Rosenberg, Richard M., "Banking on the New America," speech delivered at the University of California, Berkeley, December 14, 1994, p. 2.

[2]Morrison, Richard, "Developing an Environmental Strategy in the Financial Services Industry," speech delivered at the University of California, Irvine, Graduate School of Management, November 1, 1991, p. 10.

[3]Ibid., p. 10.

[4]Fortune, "Environmentalists Are On the Run," September 19, 1994, p. 103.

[5]Timothy Beatley, "Preserving Biodiversity Through the Use of Habitat Conservation Plans," in Douglas R. Porter and David A. Salvesen, Collaborative Planning for Wetlands and Wildlife, Washington D.C.: Island Press, 1995, p. 57.

[6]"Accord is Reached to Aid Forest Bird," New York Times, April 16, 1993.

[7]"Interior Secretary Is Pushing A New Way to Save Species," New York Times, February 17, 1993.

[8]Sally W. Smith, "Wildlife and Endangered Species: In Precipitous Decline," in Palmer, Tim, ed. California's Threatened Environment: Restoring the Dream, Washington D.C.: Island Press, 1993. p. 227.

[9]Interview with Bruce Babbitt, Rolling Stone, July, 1993.

Bank of America and the Carlsbad Highlands Foreclosure (A)

PLEASE!

**DO NOT READ
THE "B" CASE
UNTIL AFTER THE "A"
CASE HAS BEEN DISCUSSED**

Bank of America and the Carlsbad Highlands Foreclosure (B)

by

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Bank of America and the Carlsbad Highlands Foreclosure (B)

On April 7, 1995, Bank of America announced the creation of the nation's first multi-species "conservation bank," to be located on the Carlsbad Highlands property. In a reception at the Olympic Resort Hotel in Carlsbad--attended by about 70 government officials, environmentalists, and developers--bank officials joined with representatives of the California Resources Agency and the U.S. Department of the Interior to praise the conservation bank concept as an important innovation in the effort to integrate economic and environmental objectives.

A conservation bank, bank officers explained, was a parcel of habitat managed for its natural resource values. The benefits of this management could be sold as "credits" to private developers or public agencies to mitigate impacts to endangered or threatened species or biologically sensitive habitats elsewhere.

In this instance, credits in the Carlsbad Highlands conservation bank would be available for sale to developers requiring mitigation anywhere in San Diego County, on an acre for acre basis. Because the conservation bank had already been approved by government regulators, developers would be spared the

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By Anne T. Lawrence, College of Business, San Jose State University, San Jose, CA 95192-0070. Originally presented at the annual meeting of the Western Casewriters Association, March 1996. Research was supported in part by the San Jose State University College of Business. This case was written with the cooperation of the Bank of America and its officers and of federal, state, and regulatory agencies, solely for the purpose of stimulating student discussion. All persons and events are real. Copyright by the author, 1996.

often costly and time-consuming process of locating and purchasing acceptable mitigation property. The price of credits would be established by the market, with a portion of the sales price allocated to support an endowment fund. This fund would enable the Carlsbad Highlands property to be permanently and professionally managed as an open-space wildlife preserve as part of the Natural Communities Conservation Program (NCCP) in San Diego County.

The agreement to establish a conservation bank on the site of the Carlsbad Highlands property had been the outcome of over a year of delicate negotiations among Bank of America; federal, state, and local regulators; developers; and environmentalists. These negotiations had been facilitated by a consulting firm, McCollum and Associates, hired by Bank of America. Just two days earlier, B of A and California regulators had signed a formal implementation agreement, under which credits in the Carlsbad Highlands conservation bank had been officially approved as satisfying state mitigation requirements. Now, many of those involved in these negotiations had gathered at the hotel to celebrate the successful conclusion of their efforts.

U.S. Secretary of the Interior Bruce Babbitt, who had flown in for the event to underscore its importance, told the group that conservation banks could become an important tool in the effort to create a regional network of open-space preserves. "This program will provide landowners in the Carlsbad area another creative option that strikes a balance between conservation and development in regional conservation planning," he said. "Market-based options that provide certainty and flexibility for private landowners offer a constructive path to

effective conservation solutions. The model program offered here by Bank of America is an important new conservation tool."[1]

Martin Stein, Bank of America Vice Chairman, praised the conservation bank as "a common-sense, market-based initiative that will help move development forward while still providing a significant level of environmental protection. As a business that is committed to economic growth and a healthy environment," he added, "we're excited about this historic, collaborative agreement that will help us reach both these goals."[2]

Michael Mantell, representing the California Resources Agency, said that the conservation bank would help "cut the red tape" facing builders trying to develop environmentally sensitive land and would help the state integrate environmental and economic objectives.[3]

In a statement released to the press, Bank of America explained the benefits of the conservation bank to various stakeholders:

> The Conservation Bank will eliminate a layer of approvals that landowners now face when developing land that contains endangered and threatened species.
>
> Bank of America gains a more rational market value for land that it took possession of through foreclosure.
>
> Environmental interests benefit by having environmentally valuable resources set aside in a regional context and managed with earnings from an endowment fund.[4]

At the same time, the California Resources Agency and the California Environmental Protection Agency jointly announced the adoption of an official policy on conservation banks, modeled after Carlsbad Highlands, to encourage the creation of similar banks throughout the state. Under the new guidelines, state regulators agreed to endorse the use of conservation banks as an

important tool for promoting the conservation of resources. The policy established a mechanism for negotiating agreements between owners of environmentally sensitive land and the appropriate regulatory agencies that would establish conservation banks. It also agreed to train state regulators in how to set up conservation banks, and specified minimum standards for their professional management.[5]

Commenting on the simultaneous announcement of the state guidelines, Bank of America officials expressed the hope that "the [Carlsbad Highlands] Conservation Bank...will serve as a model for the creation of similar conservation banks in California and the U.S."[6]

Notes

[1]San Diego Union Tribune, "Interior Secretary Lauds Creation of Carlsbad Conservation Bank," April 8, 1995, p. B8; and Bank of America, "Bank of America and Wilson Administration Announce Multispecies Conservation Bank in San Diego," press release, April 7, 1995, p. 3.

[2]Bank of America, "Bank of America and Wilson Administration Announce Multispecies Conservation Bank in San Diego," press release, April 7, 1995, p. 2.

[3]San Diego Union Tribune, "Interior Secretary Lauds Creation of Carlsbad Conservation Bank," April 8, 1995, p. B8.

[4]Bank of America, "Conservation Banking: A Market-Based Approach to Development and Habitat Protection," no date, circa April, 1995, p. 2.

[5]California Environmental Protection Agency and The Resources Agency, "Official Policy on Conservation Banks," April 7, 1995.

[6]Bank of America, "Bank of America and Wilson Administration Announce Multispecies Conservation Bank in San Diego," press release, April 7, 1995, p. 1.

Chart 1: Reasons for Alliances

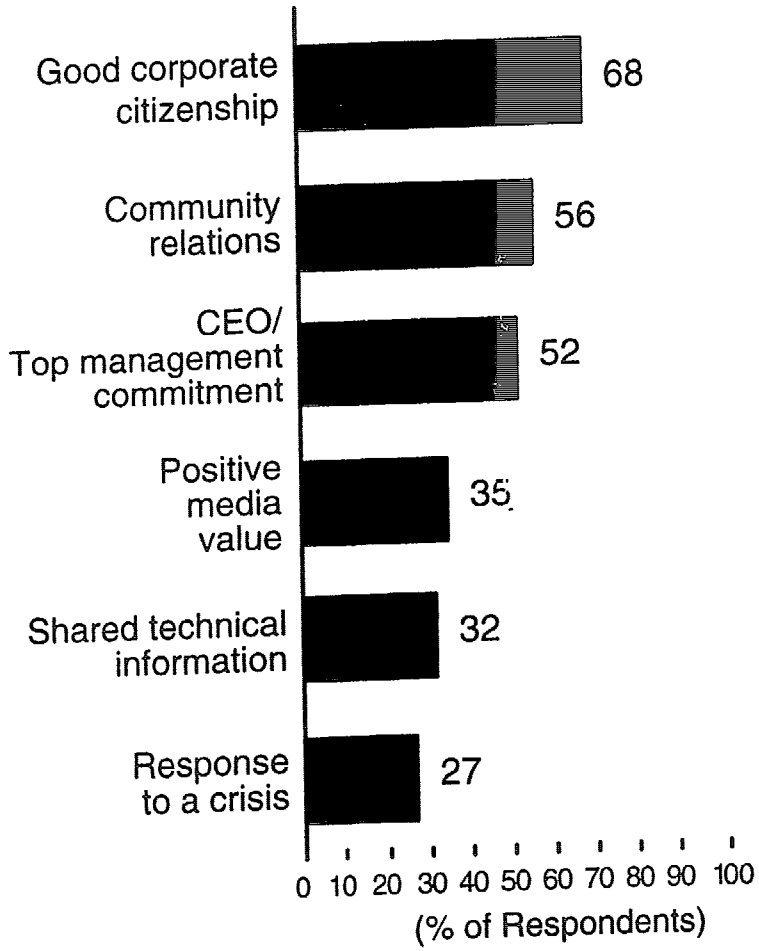


Chart 2: Outcomes From Alliances

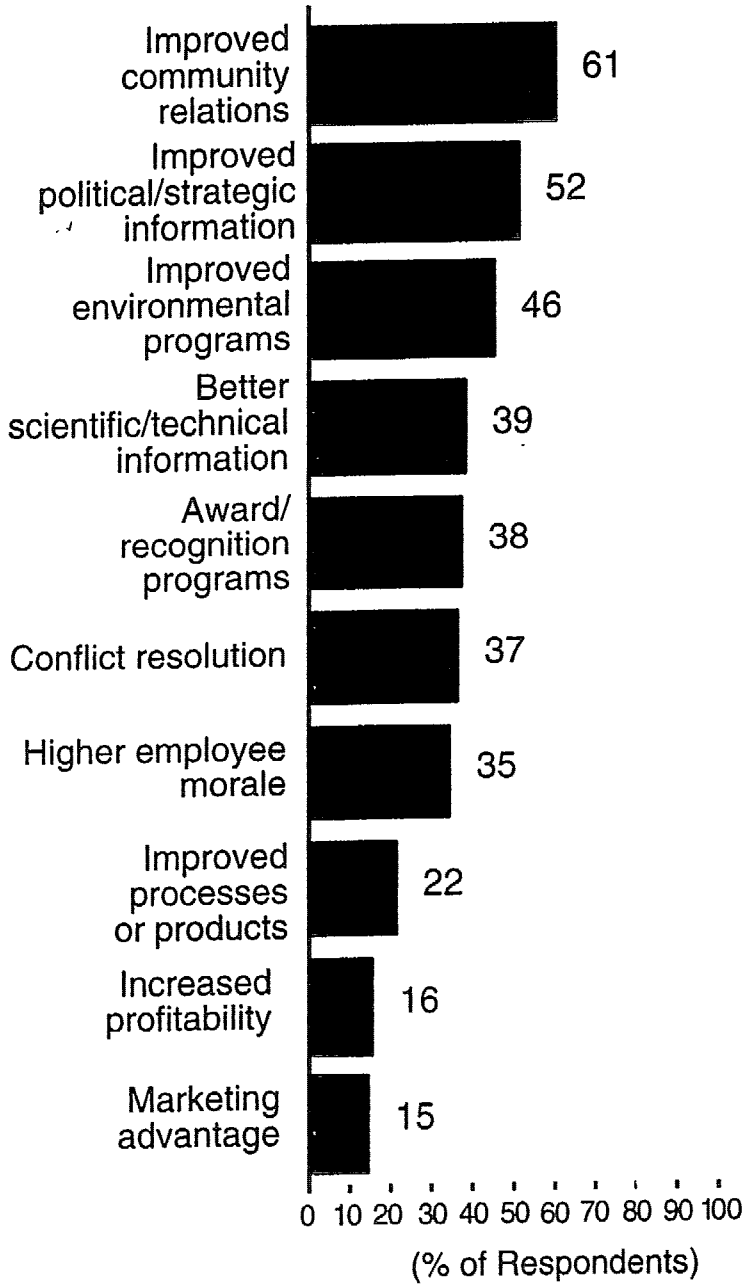


Chart 3: Critical Elements to Initiating Alliances

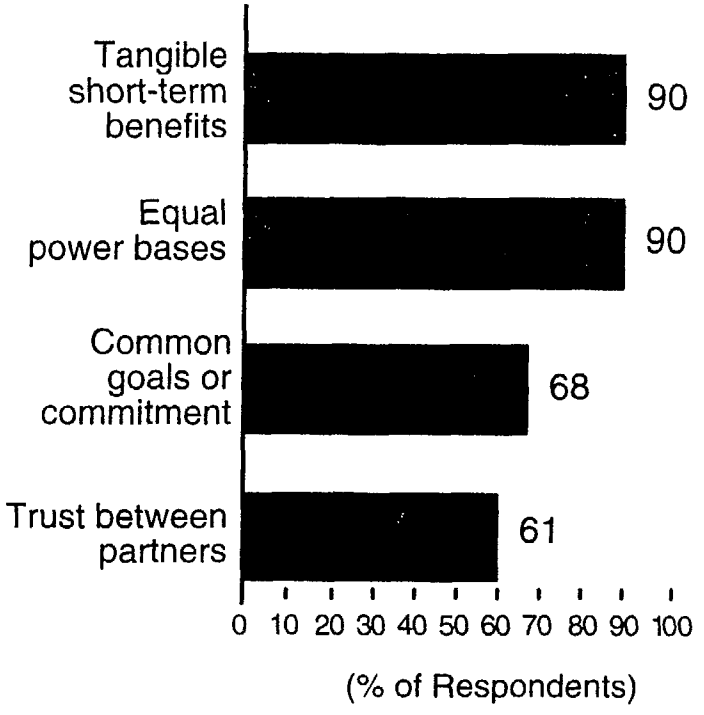
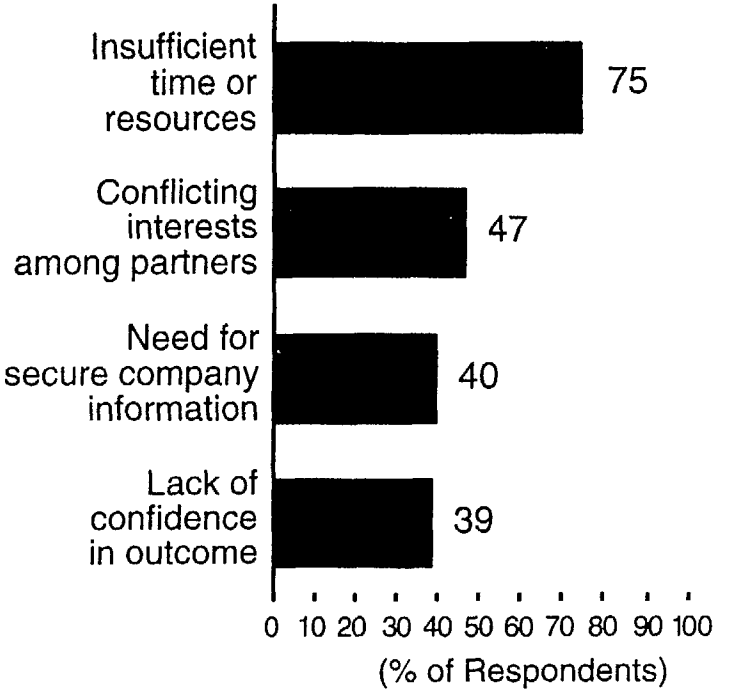


Chart 4: Obstacles to Building Alliances*



* Lack of support from top management was not seen as a major problem.

February 16, 1998

Module III

Jungle Survival

THE SITUATION

It is approximately 4 p.m. on November 2. You are aboard a small, chartered twin-engine plane traveling north from Panama City to the Caribbean island region of the San Blas Archipelago. This is the last leg of your two-week trip and you are excited about attending the Panamanian Independence Day celebration the next day. Settling in for the 45-60 minute flight, you look out the window and notice dark clouds forming above the mountainous rain forest far below.

You remember hearing before take-off that a weather system called the Intertropical Conversion was moving in from the south. The radio bulletin had warned of thick cloud cover and torrential rains, lasting anywhere from two days to one month. As rain begins to pelt your plane window, you suddenly feel very uneasy about flying.

Thirty minutes later, the plane begins losing altitude until it is flying just above the rolling terrain of the tree-covered jungle canopy. Streams and rivers periodically break up this wide, green expanse. The craft sways roughly as it is buffeted by downdrafts and the blinding storm. The pilot fails to establish radio contact and announces that he must turn back. Although you are 15 miles from the Caribbean Sea, it is impossible to cross the mountains to reach the coast. Instead, you must reverse course toward the Pacific, some 50 miles away.

The plane drops dramatically in mid-turn, and you realize it will crash. Seconds later, the plane stalls and tears across the tree tops. Its tail is completely severed. Branches crash through the windshield, killing the pilot and demolishing the instrument panel.

After two sudden falls, the plane becomes enveloped by huge tree branches. It is teetering precariously in the wind and rain at a 45-degree angle, 50 feet above the steep slope of the jungle floor. Although in shock, you are physically unharmed. You notice the smell of gasoline.

Your group quickly struggles to the ground using hanging vines. The wet, thorny foliage surrounds you and soaks your lightweight clothing. As you listen to the screeches of disturbed wildlife and the buzzing of insects, you feel the threatening jungle night closing in.

THE CHALLENGE

In a frantic effort to find some kind of security and comfort before dark, your group searches the ground below the wreckage and finds 15 items scattered about. Your task is to rank these items according to their importance to your survival in the Panama tropical rain forest, starting with "1" as the most important, to "15" as the least important.

You may assume —

1. the number of survivors is the same as the number on your team;
2. you are the actual people in the situation;
3. the team has agreed to stick together;
4. all items are in good condition.

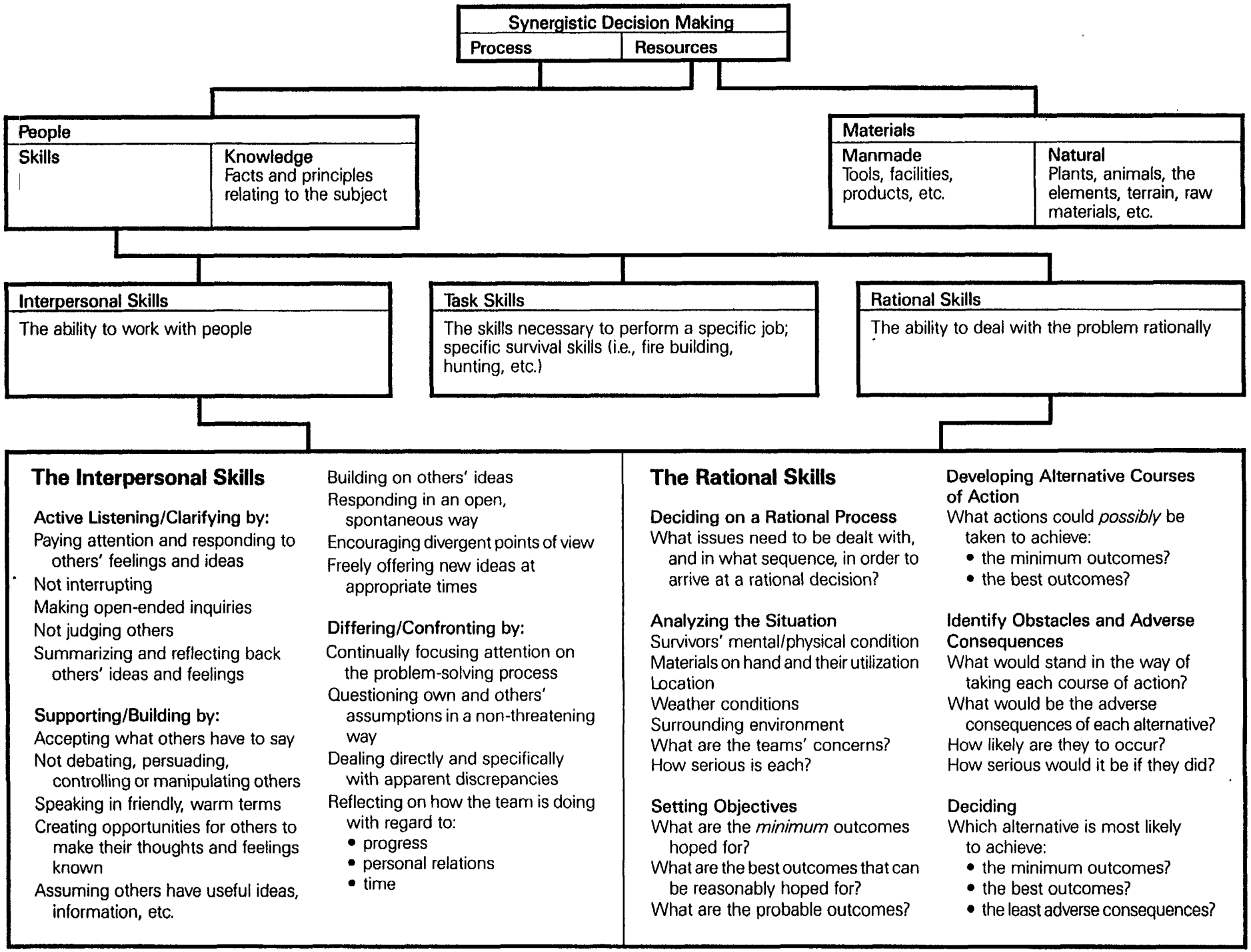
Step 1: Each member of the team is to individually rank each item. Do not discuss the situation or survival items until each member has finished the individual ranking.

Step 2: After everyone has finished the individual ranking, rank order the 15 items as a team. Once discussion begins, do not change your individual ranking.

Your team will have until _____ o'clock to complete this step.

— ITEMS —	STEP 1 Your Individual Ranking	STEP 2 The Team's Ranking	STEP 3 Survival Expert's Ranking	STEP 4 Difference Between Step 1 & 3	STEP 5 Difference Between Step 2 & 3
First Aid Kit					
Portable Transistor Radio					
Disposable Cigarette Lighter					
3 Golf Clubs					
7 Large Green Garbage Bags					
Compass					
Gift Wrapped Decorative Candle (3" circumference)					
.38 Caliber Pistol (loaded)					
Bottle of Liquid "GI-Type" Insect Repellant (2 oz.)					
Machete					
Snake Bite Kit					
1 Quart of Rum					
1 Box of Granola Bars					
Plastic "Space Blanket" (7' × 5½')					
1 Gallon Thermos (empty)					
			TOTALS *(The lower the score the better)*		
				YOUR SCORE *(Step 4)*	**TEAM SCORE** *(Step 5)*

Please complete the following steps and insert the scores under your team's number.	TEAM NUMBER 1	2	3	4	5	6
STEP 6 AVERAGE INDIVIDUAL SCORE — Add up all the individual team member's scores (Step 4) and divide by the number on the team.						
STEP 7 TEAM SCORE (Step 5 above)						
STEP 8 GAIN (LOSS) SCORE — The difference between the Team Score and the Average Individual Score. If the Team Score is lower than Avg. Ind. Score, gain is "+"; if higher, gain is "–".						
STEP 9 PERCENTAGE CHANGE — Divide the gain (loss) by the Average Individual Score.						
STEP 10 LOWEST INDIVIDUAL SCORE — on the team (best score).						
STEP 11 NUMBER OF INDIVIDUAL SCORES — lower (better) than the team score.						


Synergistic Decision Making
Process
Resources
People
Skills
Knowledge
Facts and principles relating to the subject
Materials
Manmade
Tools, facilities, products, etc.
Natural
Plants, animals, the elements, terrain, raw materials, etc.
Interpersonal Skills
The ability to work with people
Task Skills
The skills necessary to perform a specific job; specific survival skills (i.e., fire building, hunting, etc.)
Rational Skills
The ability to deal with the problem rationally
The Interpersonal Skills
Active Listening/Clarifying by:
Paying attention and responding to others' feelings and ideas
Not interrupting
Making open-ended inquiries
Not judging others
Summarizing and reflecting back others' ideas and feelings
Supporting/Building by:
Accepting what others have to say
Not debating, persuading, controlling or manipulating others
Speaking in friendly, warm terms
Creating opportunities for others to make their thoughts and feelings known
Assuming others have useful ideas, information, etc.
Building on others' ideas
Responding in an open, spontaneous way
Encouraging divergent points of view
Freely offering new ideas at appropriate times
Differing/Confronting by:
Continually focusing attention on the problem-solving process
Questioning own and others' assumptions in a non-threatening way
Dealing directly and specifically with apparent discrepancies
Reflecting on how the team is doing with regard to:
• progress
• personal relations
• time
The Rational Skills
Deciding on a Rational Process
What issues need to be dealt with, and in what sequence, in order to arrive at a rational decision?
Analyzing the Situation
Survivors' mental/physical condition
Materials on hand and their utilization
Location
Weather conditions
Surrounding environment
What are the teams' concerns?
How serious is each?
Setting Objectives
What are the minimum outcomes hoped for?
What are the best outcomes that can be reasonably hoped for?
What are the probable outcomes?
Developing Alternative Courses of Action
What actions could possibly be taken to achieve:
• the minimum outcomes?
• the best outcomes?
Identify Obstacles and Adverse Consequences
What would stand in the way of taking each course of action?
What would be the adverse consequences of each alternative?
How likely are they to occur?
How serious would it be if they did?
Deciding
Which alternative is most likely to achieve:
• the minimum outcomes?
• the best outcomes?
• the least adverse consequences?

February 17, 1998

Module I

Total Quality Management

ISO

Industrial Engineering
and Operations Research
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Total Quality Management: A Methodology for Pollution Prevention

Prepared by Leith Harmon, NPPC Research Assistant, under the supervision of Katta Murty, Professor of Industrial and Operations Engineering, University of Michigan.

Introduction

As a result of global competition, consumers demand better product and service quality. At the same time, some consumers' environmental concerns continue to grow. Total Quality Management (TQM), a system that can help companies achieve high product and service quality, has inherent strengths that effectively address some environmental issues.

Professionals who apply TQM concepts to environmental issues have coined the term Total Quality Environmental Management (TQEM). This is a logical method for producing the results of another concept gaining speed in industry: pollution prevention. This paper explains how the concepts of TQEM can be employed to successfully prevent pollution.

Background

In *Total Quality Control,* Armand Feigenbaum defines product and service quality as:

> [T]he total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectations of the customer.[1]

To achieve product and service quality many organizations employ TQM. Its management elements include:

- Customer focus
- Continuous improvement
- Teamwork
- Strong management commitment

Yet, who is the customer, and how can TQM principles be applied to environmental concerns?

CUSTOMER FOCUS

In the context of quality, the customer is defined as the person who "employs the product and service characteristics."[2] Customers fall into two categories. The *internal* customer is the next person in the production chain; the *external* customer is the end-user of the product. For instance, in the auto industry, the person who installs the bumper is an internal customer to the department producing the bumpers; the external customer is the purchase of the finished car.

If the definition of the customer is expanded to include the people and environments effected by production process *waste,* TQM requires us to understand how this waste affects those customers and take steps to reduce it. Both W. Edwards Deming and Kiyoshi Suzaki, legends in the field of TQM, have defined waste as "that which does not add value."[3] For this paper, we define waste more specifically: the physical by-products of a process. This can be excess paper in an insurance office as well as waste chemicals from a paper mill. When we more narrowly define waste, the principles of its elimination put forth by Deming and Suzaki are no less pertinent.

As an example, many industries use the solvent trichloroethylene (TCE) in their operations. This highly toxic chemical must be contained in a closed system, as releases of TCE can be fatal. Such releases often require the evacuation of the entire facility. Here the plant workers are the unwilling internal customers of TCE fumes. The external environment is also an unwilling customer. Rivers downstream can be affected by the effluent of a paper mill or oil refinery. Aquatic life in the river and people dependent on the river for drinking water are unwilling customers of this effluent.

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Strong Management Commitment

It should now be clear that three of the elements of TQM — customer focus, continuous improvement, team approach — readily apply to environmental issues. As in traditional TQM settings, the last — strong management commitment — is perhaps the most important. No TQEM program will succeed without the commitment of senior management. Senior management, those who have built their careers when waste was seen as a necessary by-product, must come to understand that both internal and external customer expectations include environmentally conscious products and processes. They must learn to see the value of applying TQEM to get to the root causes of waste, and call on the cross-disciplinary teams to employ continuous improvement to implement ever "cleaner" solutions.

Conclusion

In the manufacturing setting today, the focus on environmental issues mirrors the focus on quality issues in the 1980s. As environmental regulations get stricter and more costly, as consumers demand more environmentally conscious products, and as competitors begin to see economic benefits from reducing waste, industrial management will employ TQEM as it employed TQM throughout the 1980s. The technology and the innovative spirit of employees exists; it must now be focused on the root cause of process waste to reap the rewards.

ENDNOTES

[1] Armand V. Feigenbaum. *Total Quality Control.* New York: McGraw-Hill, 1991, p 7.

[2] ibid.

[3] W. Edwards Deming. *Out of the Crisis.* Cambridge, MA: MIT, 1986, p. 92.

Kiyoshi Suzaki. *The New Manufacturing Challenge.* New York: The Free Press, 1987, p. 8.

[4] It is worth noting that some process waste (such as some wastewater) is relatively benign to the environment. The principles of TQEM should be focused on those waste streams that pose the highest risk to environmental and human health.

[5] President's Commission on Environmental Quality, Quality Environmental Management Subcommittee. *Total Quality Management: A Framework for Pollution Prevention.* Washington, 1993.

[6] Current accounting systems often neglect to apply the costs of toxic waste removal and potential liability and fines (under ever-tightening regulations) directly to the process department. These costs are generally grouped together for the whole facility. When these costs factored in, the "clean" solution often appears more attractive.

Questions

1. Relate how TQM principles apply so well to environmental issues.
2. Name three environmental customers that might be affected by a facility's waste.
3. Why is the traditional approach to industrial waste handling insufficient?
4. Why is it necessary to use the team approach when attacking waste issues?
5. What are some ways to make senior management more aware of the benefits of TQEM?

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The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materialsand conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

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What is ISO?

- International Organization for Standardization
  - Worldwide federation founded in 1946 to promote the development of international manufacturing, trade, and communication standards.
  - Greek = "equal"

What is ISO 14000?

- A developing series of management standards for helping organizations manage environmental aspects of their operations.
- Two Types:
  - Specification (ISO 14001 EMS standard only)
  - Guidance

Environmental Management System

Dimensions of the overall management function of an organization that develop, implement achieve, review and maintain the environmental policy, including organizational structure, responsibilities, practices, procedures, processes and resources.

ISO 14001 EMS status and applicability

- TC 207 formed in January 1993
- ISO 14001 IS published in Sept., 1996
- Designed to be applicable to:
  - Any type of product/service
  - Any country
  - Any size organization
  - Can be adopted at corporate and/or facility level
- ISO 14010-2 Audit guidlines ratified in Oct.

ISO EMS Definitions

- Environment; Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. The environment in this context extends from within an organization to the global system.
- Environmental Aspect; Elements of an organization's activities, whether adverse or beneficial, wholly or partially resulting from an organisation's activities products and services.
- Environmental Impact; Any change in the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities products, and services.
- EMS Audit; Systematic and documented verification process to objectively obtain and evaluate evidence to determine whether an organization's environmental management system conforms to the EMS audit criteria.

ISO EMS Definitions (cont.)

- Environmental Performance; Measurable outputs of the environmental management system, relating the organization's control of the impact of its activities,products, and services on the environment, based on its environmental policy, objectives, and targets.
- Environmental Objectives; Overall environmental goals, arising from the environmental policy and significant impacts, that an organization sets itself to achieve, and which are quantified wherever practicable.
- Environmental Target; Detailed performance requirement, quantified wherever practicable, applicable to the organization or parts thereof, that arise from the environmental objectives and that need to be set and met in order to achieve those objectives.
- Environmental Policy; Statement by the Organization of its intention and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its environmental objectives and targets.

ISO 14001; Commitment and Environmental Policy

- Principle 1; An organization should first focus on what needs to be done-it should ensure commitment to environmental management and define its policy.
- Top management shall define the organization's environmental policy and ensure that it;
  - Is appropriate to the nature, scale and environmental impacts of its activities, products and services.
  - Includes a commitment to continual improvement and prevention of pollution
  - Include a commitment to comply with relevant environmental legislation and regulations
  - Provides a framework for setting objectives and targets
  - Is documented, implemented and maintained and communicated to all employees
  - Is available to the public.

ISO 14001; Planning

- Principle 2; An organization should formulate a plan to fulfill its environmental policy.
- Environmental Aspects
- Legal and other requirements
- Objectives and targets
- Environmental Management Program

ISO 14001; Implementation

- Principle 3; For effective implementation an organization should develop the capabilities and support mechanisms necessary to achieve its policy, objectives, and targets.
- Structure and responsibility
- Training, awareness and competence
- Communication
- Documentation and document control
- Operational control
- Emergency preparedness and response

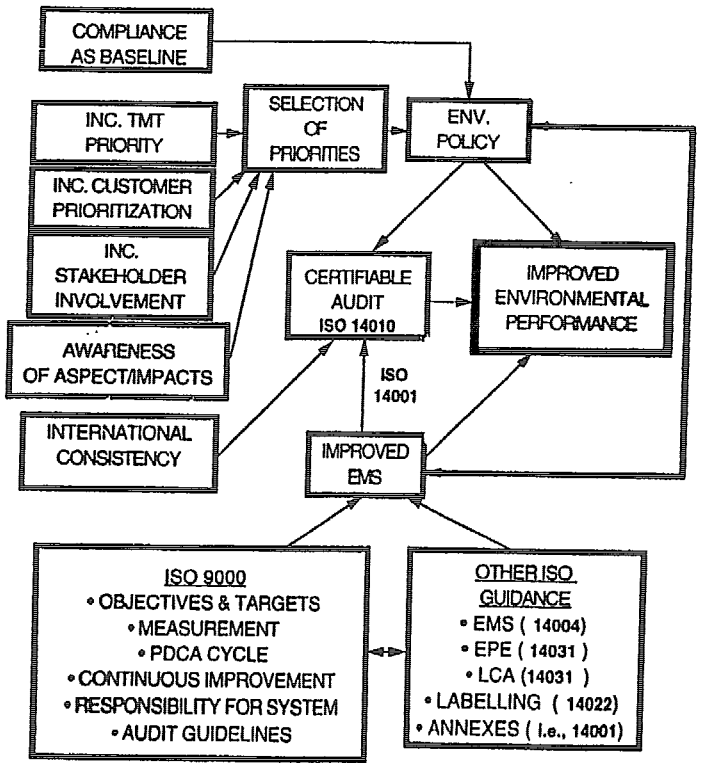
ISO 14001; Measurement and Evaluation

- Principle 4; An organization should measure, monitor and evaluate its environmental performance.
- Monitoring and measurement
- Non-conformance and corrective and preventive action
- Records
- EMS System Audit

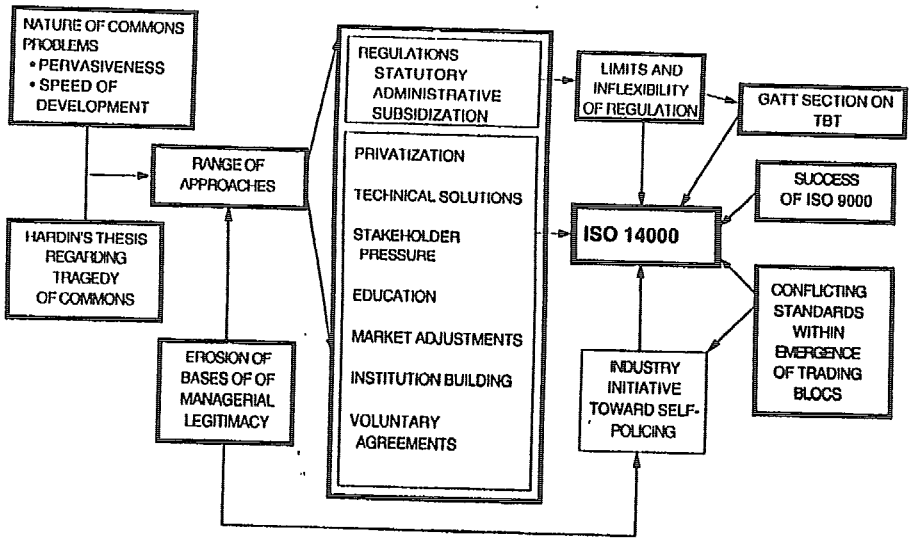
ISO 14001; Management Review

- Principle 5; An organization should review and continually improve its environmental management system, leading to an improvement in overall environmental performance.

HOW ISO 14000 IMPROVES ENVIRONMENTAL PERFORMANCE?



FACTORS PROMOTING THE DEVELOPMENT VOLUNTARY CONSENSUS STANDARDS



February 17, 1998

Module II

International Hardware Products, Inc.

ISO 14001 Overheads

WORLD RESOURCES INSTITUTE

Management Institute for Environment and Business
A program of the World Resources Institute

International Hardware Products, Inc.

Considering an ISO 14001 Environmental Management System

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In the fall of 1995, Rick Thompson, manager of quality assurance at International Hardware Products of Tennessee (IHP), learned that the International Organization for Standardization (ISO) in Geneva, Switzerland, was nearing international consensus on a Draft International Standard for environmental management systems (EMS). Such a standard would outline the framework for an integrated and cross-functional organizational system that would address organizations' responses to environmental issues. Because Rick was intrigued with the prospect of repeating IHP's success with the ISO 9001 quality management standard, he began gathering basic information about the standards specified in ISO 14001 and about the registration process.

This case study was prepared by Professors Thomas J. Dean and Gerald E. Fryxell of the University of Tennessee at Knoxville as the basis for class discussion rather than to illustrate either effective or ineffective management strategies. While the case is based on consulting work with the company, the company's identity has been disguised.
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Late in 1996 the ISO 14001 standard was completed, and Rick pondered the implications of registration[1]. His plant had always been at the forefront of emerging developments in its industry and was known throughout the company for being innovative. Rick was proud, for example, that the Tennessee facility was the first facility within the company to obtain ISO 9001 registration for its quality management program. Indeed, the results of that program were impressive -- both in terms of improved product quality and financial returns (through lower unit costs and improved sales from customer satisfaction). Moreover, as a forerunner in implementing ISO 9001, his facility had benefited in other ways. For example, by providing training to other divisions within the company, IHP of Tennessee had gained a measure of prestige and had, more tangibly, received direct transfers from those divisions as payment. Those payments, in particular, had been welcome because the facility's parent corporation was very cost-conscious and ran each division as a strict profit center.

Rick debated whether or not to make an all out push for registration. On the positive side, he had heard that companies with ISO 9001 registration would already have many of the organizational elements in place for registration to these new standards. Moreover, the parent company had mentioned its commitment to the environment in its corporate policy statement. Many academics and practitioners were also claiming that a more proactive approach to environmental issues might create cost savings and even competitive advantage. On the other hand, Rick was somewhat skeptical about whether registration would pay off financially (and he was sure that "corporate" would be even more concerned about this). He was quite uncertain where the cost savings would come from, and the costs of 14001 implementation were substantial. Consultants suggested that the total cost of program start-up and registration to the standards would be $100,000 to 150,000. This estimate did not, however, include on-going expenses to maintain the program. There were continual administrative, training, auditing, and other costs associated with the system. He was also uncertain about how much ISO 14001 registration would be valued by IHP's customers. While many of IHP's customers required ISO 9001 registration, it was unclear whether they would be moving to require ISO 14001 registration. If they did, his facility and the parent corporation might gain a much welcomed competitive advantage.

While Rick personally felt that ISO 14001 would help his Tennessee plant stay on the leading edge of industry developments and maintain its reputation within the company, he knew that he would have to make a strong and clear case to corporate about the costs, benefits, and feasibility of such a project. To complicate matters somewhat, the parent company was currently preoccupied with acquisitions. The parent had already made many acquisitions this year, and it was rumored that it would soon close on its largest deal. Down deep he knew getting additional resources for ISO 14001 registration would be a tough sell.

IHP of Tennessee

With 320 employees at the 225,000-square-foot facility, International Hardware Products Corporation of Tennessee is a moderate-size manufacturer of stamped metal products. Although the company makes other varieties of hardware products, the bulk of its production and revenues is derived from the manufacture of door hinges, hasps, braces, and angles. Occasionally, the company obtains a contract to produce a specialized product for which it can command premium prices. For example, the company had recently completed an

1. While it is common to refer to these standards as ISO 14000, the only section specifying standards for certification is 14001.

order for hardware used in the construction of a large computer chip manufacturing facility. These products required a special enamel coating because dust is such a concern in making microprocessors.

Manufacturing at IHP involved a fairly simple process. Rolled steel, purchased from steel manufacturers, was cut and pressed into various shapes by a stamping machine. At this point some additional components might be added, depending on the item. For example, manufacture of a hinge would require the insertion of a pin. Other products involved some additional procedures, such as spot welding, plating, embossing, or painting. Many of the parts required galvanizing, a rust-inhibiting process that involves several hazardous materials. The primary waste streams of the operations are identified in Appendix E.

Quality in these products did have some bearing on customers' large-purchase decisions. For example, door and window manufacturers could be particular about appearance and durability; however, price was undoubtedly the main driver of most purchases. Because opportunities to differentiate such products were few, the facility had to maintain an eye on costs and maintain a high level of productivity. The company planned to discontinue inspection because of the combined influences of the simplicity of the product and the quality management system.

After manufacture, the products were boxed in cardboard and shipped by truck to the company's distribution warehouse. From there products were sold to hardware distributors, who then sold the product to hardware stores, door and window manufacturers, and large contractors. In recent years, it had been increasingly common to sell directly to large retail building supply companies, such as Home Depot and Lowe's.

The Parent Company

IHP of Tennessee was a division of IHP, Inc., a diversified corporation with many other manufacturing operations throughout North America, Europe, and Asia. The company manufactured and marketed a related line of products including hand tools, clamps, springs, metal fasteners, and stamped parts for small-appliance OEMs. In all its operations, IHP, Inc. employed over 8,000 people.

The corporation focused on creating customer value and maintaining leadership through innovative engineering, low-cost manufacturing, and the ability to satisfy customers. One of its primary objectives was to achieve growth in sales averaging eight percent per year; after-tax profit on sales of 11 percent; and return on average equity of 16 percent. Three trends in manufacturing were the fundamental drivers of the company's strategic approach: (1) companies were under pressure to combine superior product quality with lower costs and rapid response to customer needs; (2) closer relationships were being forged with a smaller number of suppliers; and (3) industry consolidation and economies of scale benefited leading companies. As a result, IHP's strategy focused on meeting customer needs, continually driving costs down, and aggressive growth through acquisition.

Corporate Environmental Policy and Performance

While IHP of Tennessee had yet to develop its own environmental policy, Rick's research revealed that the parent company had established a formal policy. Rick was somewhat surprised, even a bit concerned, by the content of the corporate policy. IHP's corporate environmental policy was:

> To use and dispose of all substances and wastes in a safe and lawful manner, and to avoid creating harm to human health and the environment. To implement this policy IHP is committed to:

1. comply with relevant laws and regulations

2. analyze, identify, and mitigate environmental, health, and safety (EHS) hazards that result from IHP's operations

3. conduct programs to ensure awareness of and compliance with applicable laws and competent response to emergency situations.

The policy also established an EHS Committee to oversee the implementation of the policy. This committee was headed by the company's counsel, Walter Lundgren, and met twice a year. The policy charged the division and/or subsidiary presidents with the responsibility of ensuring compliance across their operations and facility managers with responsibility for compliance within their own plants. In addition, the policy stated that all facility managers were obligated to be aware of environmental risks and standards, manage those risks, and take appropriate action to ensure compliance.

The Council on Economic Priorities (CEP) was a privately supported organization that provided information to the public about the performance of large companies on a range of social issues. In its report on IHP, CEP provided a general description of corporate performance with limited information on IHP of Tennessee. Environmental information in the report included Toxic Release Inventory (TRI) data, Pending Litigation, and Partnerships in EPA initiatives.

Toxic Release Inventory (TRI). As a corporation IHP was compared to other firms in its industry. In terms of total releases IHP was reported to be "better than average." However, this low release rate was mostly due to the fact that IHP was much smaller than the average firm in its industry. When TRI data were adjusted by total sales, then IHP was "worst" in its comparison group. Another way to look at the TRI data is to look for trends over time. IHP released 950,000 pounds of toxins in 1988 (or 1.1 pounds per dollar of sales); 560,000 pounds in 1989; and 360,000 pounds in 1990 (or 0.65 per dollar of sales). For the IHP Tennessee plant the primary toxic releases were zinc compounds, which were transferred off-site.

Pending Litigation. The U.S. Environmental Protection Agency identified IHP as a potentially responsible party at four Superfund sites. Aside from litigation related to the Superfund sites, the CEP found no significant environment-related litigation in which IHP was involved from January 1986 to December 1993. During this same period there were three regulatory violations--both involved hazardous waste violations for which the company was not assessed any fines.

Partnerships in EPA Initiatives. IHP had not joined two of EPA's principal voluntary programs - the Industrial Toxins Project (33/50), which attempted to reduce the generation of 17 acutely toxic chemicals, and the "Green Lights" Program, which attempted to improve lighting efficiency.

ISO 14001 and Environmental Management Systems

The International Organization for Standardization (ISO) was a worldwide federation founded in 1946 to promote the development of international manufacturing, trade, and communication standards. Originally, ISO formed out of a need for common measures and technical specifications to facilitate commerce and the use of products in multiple nations. Most nations had representation within ISO, and the American National Standards Institute (ANSI) was the U.S. representative. Before the ISO 9001 quality *management* standards, all standards promulgated by ISO had been *technical*.

Continuous Improvement

Those who have embraced TQM understand that quality can only be *built* into the product, not *inspected* into. This requires the producer to continuously identify and eliminate the root causes of impediments to quality. Continuous improvement is also the key to reducing the environmental impacts of the production process.

The traditional approach to industrial waste has been to view it as a necessary, though unwanted, by-product of manufacturing. While production generates the waste, the responsibility to dispose of the waste in a safe and legal manner usually falls on the environmental engineering department. Because environmental engineers receive the waste after it has been created, they are not intimately familiar with the processes that create it. Further, because waste reduction is not a component of their performance reviews, they do not have the institutional motivation to reduce the waste.

The environmental engineering department is also responsible for completing government forms documenting the facility's wastes. Government regulations are created to ensure the health of plant workers, the surrounding community, and the environment in general. However, these regulations often create requirements that are very cumbersome and expensive for industry. For instance, under the Superfund law, a Toxic Release Inventory (TRI) must be completed each year. The TRI process, which records the volumes of waste generated by a facility, requires paperwork that can take up to three months to complete; like product quality inspection, this is certainly not value-added! Replacing toxic materials used in the manufacturing process with more environmentally benign materials reduces the paperwork.

TQEM is the logical method for preventing pollution wherever possible. Employing a customer focus and classifying the waste itself and the activities required to control it as non-value-added, TQEM calls for waste generation to be brought to a minimum.[4] Operators and process engineers, not environmental engineers, are responsible for identifying and eliminating the root causes of process waste. Employing the continuous improvement approach, "zero waste" is as important a goal as "zero defects."

As a result of TQEM projects, product quality often improves while waste is reduced. One possible explanation might be that TQEM efforts empower employees to become more familiar with all aspects of the process, not those just associated with production. When employees are forced to consider process wastes, improvements to quality characteristics can result.

Teamwork

The team approach allows all factors of the environmental issue to be considered. Accountants are familiar with cost considerations, product engineers are familiar quality considerations, process and chemical engineers are familiar with feasibility considerations, and environmental engineers are familiar with environmental impacts. Because environmental engineers are trained to deal with waste *after* it has been generated, and not in methods of preventing it from being created in the first place, engineers with knowledge of the process characteristics must be involved.

For example, degreasing certain aluminum components with TCE has required extensive safety mechanisms and procedures. Building better containment systems reduces the risk of exposure, but does not get to the root cause of the problem — the use of TCE. With this in mind, Ford, an active TQEM proponent, looked for a TCE-free solution to degreasing radiator coils.[5] Ford formed a team that included a chemical engineer, an environmental engineer, a process engineer, an accountant, and a product engineer. The variety of backgrounds on the team ensured that the pertinent issues of cost, product quality, process feasibility and environmental impact were all addressed. The Ford team designed an aqueous degreasing system (i.e., soap and water) to replace the TCE. Not only does the plant avoid using this toxic chemical, but the water in the new system is recycled as well. Significantly, the aqueous degreaser exhibits better quality characteristics than the TCE degreaser.

The above project is an example of the best of all worlds: improved quality, reduced cost, and reduced environmental impact. Certainly not all projects will prove so fruitful. Some "clean" alternatives may cost more than their polluting rivals, but that cost must be balanced with the benefits of the environmental improvement.[6] To justify this viewpoint, one needs only to look to the increasing expectations of external customers for "environmentally friendly" products.

With the success of ISO 9001 and concern surrounding the 1990 Rio Earth Summit, ISO moved to develop a series of environmental management standards and guidelines in order to aid companies in dealing with environmental issues. This series of environmental standards was developed through an international consensus-building process open to all interested constituencies (although heavy in representation from industry) and is known as the ISO 14000 series. The development of guidelines was overseen by ISO Technical Committee #207. The documents broadly addressed such issues as environmental labeling, life cycle analysis, environmental management systems, and environmental performance evaluation. An important aspect of the entire ISO 14000 series was that it was strictly voluntary; however, if ISO 9001 was any indication, certain customers -- especially those in the European Community -- would likely require registration for doing business.

Most important among the ISO 14000 series were those pertaining to environmental management systems. Two related documents directly addressed EMS. Undoubtedly of most interest was ISO 14001, which gave the registration standards (the requirements which the EMS had to meet in order for an organization to become registered). For most companies, obtaining registration was the main reason for their interest in ISO 14001. In addition, ISO 14004 provided useful guidelines which an organization could consult when implementing an EMS (but these were *not* required for registration).[2]

An EMS is a formal system used by a company to manage the environmental aspects of its business. To some extent, all organizations with environmental issues have environmental management systems, but the nature and extent of an environmental management system as exemplified in an ISO 14001-certifiable system may be much different from a company's existing system. Most companies had procedures that addressed compliance but went little beyond that. The development of the ISO 14001 standard represented a change in philosophy in organizations throughout the world in the way they approach environmental issues. Movement was away from a compliance orientation, where environmental issues were seen only through the eyes of government regulation, and toward a philosophy wherein an organization steadily reduced environmental impacts of its products and processes. The philosophy was exemplified in the five fundamental principles built into the EMS standard. These principles included commitment, planning, implementation, measurement and evaluation, and continual improvement. In short, these principles required a company to:

1. develop an environmental policy
2. identify the organization's environmental aspects
3. decide on the organization's environmental goals and objectives
4. develop formal procedures and systems for achieving its objectives
5. control and document performance relative to its goals
6. continually review and improve the system.

The assumption that an effective and functioning EMS would lead to improvements in environmental performance was key to the success and acceptance of the standard. Evidence suggested that the fundamental change in philosophy toward the environment could help organizations improve environmental performance, lower environmental management costs, and improve stakeholder relations. Furthermore, the standard

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2. Certification to ISO 14001 would normally be given by a third-party, independent registrar who audits an organization to establish that the standards are met and who grants certification (or registration in Europe). ISO 14001 may also be the basis for second-party certification, in which a customer assures that a supplier meets the standard, and first-party certification in which an organization self-declares that it has met the standards in ISO 14001.

required organizations to set objectives and targets for their significant environmental aspects. It also required a commitment to continual improvement and the prevention of pollution. As a result, it might be difficult to maintain registration to the standard without reductions in pollution levels.

However, some constituencies contended that the environmental benefits of the standard would not be as great as others claim. Their argument was supported by the fact that ISO 14001 was *not* an environmental performance standard. Indeed, nowhere in this standard were levels of pollution specified for any industry or business. Thus, it was conceivable that an organization could initially be registered to ISO 14001 with relatively high levels of emissions. ISO 14001 also permitted considerable latitude in the selection of objectives and targets, so the company needed only to focus on those priorities that were significant and to which it was willing to commit. Moreover, because the environmental improvement goals were self-imposed, one registered company's environmental performance might not equal another's. Although this difference might not seem equitable, the standard was written to be applicable to a broad array of organizations. Indeed, the standard could be applied to companies that had varied environmental considerations, cultural and industry contexts, and access to technology, infrastructure, and resources. In addition, the ISO definition of "organization" was written so that it could be flexibly applied across various organizational levels. This meant that an entire corporation could be registered, but it was more likely that in the beginning single plants or business units would seek registration to the standard. While most organizations would seek third-party registration (e.g., from an EMS auditing organization), ISO 14001 also permitted second-party auditing (e.g., to determine if a supplier meets the standard) and even self-declaration.

Time for Action

Now that the final standard had been released, Rick knew that he needed to move forward if he were to keep the Tennessee facility on the cutting edge. He was concerned about the commitment of top management to the program, whether it would really be of benefit to the company, and most importantly, the time and costs required to implement the program. In order to minimize the cost, he had decided that company personnel should design the system, rather than hiring an expensive consultant to do so. This approach also had the advantage of requiring greater participation from other managers whose commitment, Rick was sure, would be necessary for success. But Rick was also concerned that he knew little about ISO 14001 and environmental management systems. While a consultant's compliance audit (see Appendix A) showed that the facility currently complied with applicable laws, an ISO 14001 gap analysis (see Appendix B) revealed that the current environmental program was far from the system envisioned in the ISO standards. The gap analysis was performed by comparing the requirements of the ISO 14001 standard to IHP's current operations. The results showed that some of the elements were already in place to some degree but were not developed to the extent required by ISO 14001. Other elements were missing completely. The conclusion was that IHP's current EMS would require substantial modification and development to conform to the standards. Most deficiencies were related to lack of formal procedures or focusing only on environmental compliance.

The following week, Rick was scheduled to provide a presentation to corporate management on ISO 14001 registration and its costs and benefits. They would then decide whether to recommend proceeding with development of an ISO-certifiable EMS. If he got permission to move forward, Rick was supposed to present to the 14001 implementation team a preliminary environmental policy statement, a list of environmental aspects, and some objectives and targets for the facility.

As he began to work on the policy statement, he realized he did not want to just copy the IHP corporate environmental policy statement, he wanted the Tennessee plant to establish a more enlightened commitment. How did the global efforts toward sustainable development impact IHP policy? Should he attempt to make the policy conform to, or approximate, the Business Charter for Sustainable Development (published by the International Chamber of Commerce)? He also planned to benchmark the policy against other companies who were seen as leaders in the environmental management area. However, he also recognized that the facility statement had to conform to the IHP corporate environmental policy and, most important, the ISO 14001 standard. ISO registration required that the policy include a commitment to continuous improvement, to prevention of pollution, and to compliance with all relevant laws and regulations.

Writing the objectives and targets seemed to be a much more difficult task. First he needed to identify the organization's environmental aspects (environmental aspects are those elements of an organization's activities that have the potential to impact the environment, whether adverse or beneficial). He knew he wanted to move the company in the direction of life-cycle thinking and to work with suppliers on their environmental performance. He also had a pretty good characterization of the company's waste streams and the results of the compliance audit (see Appendix C). Yet it all seemed rather vague: Once we identify some of the primary aspects, how should the objectives be written? How much reduction should we expect? Where should we place our priorities? Where might we be able to save the most money through waste reduction? How do we measure the results? Still, he had to have some preliminary ideas for the following week's meeting.

Appendix A

International Hardware Products -- EMS Gap Analysis

Background

The purpose of this report is to identify current practices at IHP and compare them to the requirements of the ISO 14001 standard, identify existing gaps, and provide recommendations for future action on developing a certifiable EMS.

IHP ISO 14001 Gap Analysis

This section lists the core elements of an EMS required by ISO 14001 along with an estimation of IHP's current level of adherence to each. It should be noted that the ISO 14001 standard is not, nor will it be, a legal requirement. Therefore, any deficiencies between the standard and IHP's current practices indicate changes needed only if you choose to pursue registration. The information on the environmental activities of IHP was obtained from interviews with plant personnel. The core elements of the standard are:

1. **The organization shall establish an environmental policy.** IHP has an official corporate environmental policy. The document states that every employee is to be aware of the policy and adhere to it. The policy does not appear to be in general use in the Tennessee plant, however, and it does not specify procedures for assuring its implementation and effectiveness as required by the standard. Use of the corporate policy by IHP of Tennessee for ISO 14001 would require significant modification.

2. **The organization shall establish and maintain procedures for identifying environmental aspects.** IHP has no formal procedure for identifying its environmental aspects.

3. **The organization shall establish and maintain procedures to identify and have access to legal and other requirements applicable to its environmental aspects.** IHP has no formal procedures for identifying its legal requirements. However, corporate review of all permitting and compliance documents is available, as is corporate legal council. IHP performs an internal environmental compliance audit approximately once every three years, and personnel sometimes attend industrial extension seminars. Registration would require documented procedures.

4. **The organization shall establish and maintain documented environmental objectives and targets.** The corporate environmental policy lists general environmental objectives but no specific targets, and it appears that IHP personnel are not generally familiar with the corporate objectives. Furthermore, registration of the Tennessee plant would require that IHP generate its own set of objectives and targets (which would likely be related to the corporate objectives).

5. **The organization shall establish and maintain procedures for achieving its objectives and targets.** IHP has no procedures for achieving the corporate objectives. There are no targets and therefore no procedures for achieving them.

6. **The organization's top management shall appoint representatives with defined roles of overseeing and reporting on the EMS. It shall also provide the resources essential to the implementation of the EMS.** While personnel are assigned to IHP's regulatory compliance, top management has not appointed representatives to specifically oversee the EMS. Rick Thompson (Quality Manager) and Sandy Jones (General Foreman) are the driving force behind this effort. Limited human and financial resources have tentatively been authorized for this project by upper management.

7. **The organization shall establish and maintain procedures for training employees.** IHP provides training required by law for handling hazardous material and waste. The training does not go beyond compliance, however, and there do not appear to be formal procedures for any of the training that does occur.

8. **The organization shall establish and maintain procedures for facilitating internal and external communications.** IHP purposefully facilitates no external communication on environmental matters other than that required by law. Internal communication is likewise constrained to that required by law and is focused only on compliance.

9. **The organization shall establish and maintain documents describing the core elements of the EMS and providing direction to related documents.** IHP has no formal EMS and therefore no documents describing it.

10. **The organization shall establish and maintain procedures for document control.** IHP follows a formal corporate document retention and distribution policy. The policy for environmental documents focuses primarily on compliance and would have to be significantly modified for 14001 registration.

11. **The organization shall establish operating procedures for activities associated with identified environmental aspects.** Current operating procedures address quality and safety concerns but not environmental aspects.

12. **The organization shall establish and maintain emergency procedures.** IHP has a formal contingency plan. The plan focuses mainly on protecting human safety and does not specifically address mitigating environmental impacts. However, IHP Tennessee is currently working on spill prevention, control, and countermeasure procedures (required by regulation).

13. **The organization shall establish and maintain procedures for monitoring and measuring operations with potential environmental impacts and maintain a procedure for complying with relevant environmental regulations.** IHP has no formal method for monitoring its procedures for environmental impacts or complying with environmental regulations. It does, however, perform measurements required for permits.

14. **The organization shall establish and maintain procedures for defining responsibility for investigating, mitigating, and correcting nonconformance.** No formal procedure exists. The

general foreman of the galvanizing area is responsible for assuring environmental conformance on compliance issues but has no formal method.

15. **The organization shall establish and maintain procedures for maintaining environmental records.** IHP has procedures for maintaining quality records for its ISO 9000 program. This could provide the basis for maintaining environmental records. Currently, training records for hazardous waste and material handling are kept, along with the results of environmental audits, although no formal procedures exist.

16. **The organization shall establish and maintain procedures for periodic EMS audits.** IHP has no EMS so there are no procedures for auditing it, although they do perform periodic compliance audits as discussed.

17. **The organization's top management shall periodically review the EMS for continuing suitability, adequacy, and effectiveness.** IHP has no EMS so there is no review.

Each of these elements is summarized in Appendix B. This list illustrates that IHP has done well on environmental compliance to this point but has weaknesses in the areas of pollution prevention and mitigation and in formal procedures. There is a significant amount of work to be done to achieve registration, with a corresponding investment in time and resources. Conversely, the fact that there is so much to do indicates there may be much to gain by pursuing registration of the plant.

Appendix B

IHP Gap Analysis Summary

ISO Core Element	IHP Tennessee Standing
Environmental Policy	Yes - but needs modification
Identify Environmental Aspects	No - focused on compliance
Identify Legal Requirements	Yes - but no formal procedure
Objectives and Targets	Yes/No - some objectives, no targets
Way to Achieve Objectives & Targets	No
Approved Resources	Yes - but not sufficient for registration
Training Procedures	Yes - but no formal procedure
Communication	Yes - but needs modification
Documentation	No - no EMS so not documented
Document Control	Yes - but needs modification
Operations Control	Yes - but focused on quality and safety
Emergency Procedures	Yes - but needs modification
Monitoring/Measuring	Yes - but needs formal procedure
Correct Nonconformance	Yes - but needs formal procedure
Maintain Records	Yes - but needs modification
Audits	Yes - but focused only on compliance
Review	No - no EMS to review

Appendix C

January 5, 1996

Chuck Steiner
Industrial Extension
Nashville, TN 37996

Rick Thompson
International Hardware Products, Inc.
1500 American Way
Nashville, TN 37982

Dear Rick:

I am pleased to provide a report of the environmental compliance survey conducted at IHP on December 13, 1995. Hopefully, the report and our discussion during my visit will help with your planned efforts to adopt the ISO 14001 standard. As promised, I've also enclosed some information on oily water separation and treatment devices.

The Tennessee Department of Environment and Conservation, TDEC, may inspect your facility in the future. When that occurs, this report may be used to demonstrate efforts made to achieve on-going compliance with environmental regulations.

Only TDEC regulates environmental matters in Tennessee. My opinions do not obligate TDEC in any way.

Very truly yours,

Chuck Steiner
Waste Reduction Consultant

Appendix D

IHP Environmental Compliance Survey

Introduction

IHP manufactures stamped metal products for use with door, window, and other systems. Their facility has a few small out-buildings, but the primary building has almost 4 acres under roof. It houses all manufacturing, warehousing, and offices. The company employs about 320 persons.

IHP recently adopted an ISO 9000 - family product-quality-management standards program and plans to adopt the ISO 14001 standard when those standards are released. The emerging ISO 14001 standard relates to the management of environmental activities. It has no formal relationship to ISO 9000, but both standards emphasize establishment of a policy requiring systematic planning, implementation, checking, corrective action, and periodic high-level review.

Compliance Status

In the following paragraphs I discuss and provide comments on IHP status with respect to regulatory compliance for the waste streams they generate and for other duties possibly incurred by handling various chemical substances.

Waste Water

IHP discharges all sanitary wastewaters directly to the publicly owned treatment works (POTW). The plant also discharges, following pretreatment, the wastewaters generated by a zinc electroplating/chromium conversion coating process. Daily monitoring and frequent in-process regulation of pH assures effluent from the pretreatment process meets all sewering requisites. IHP says there have been no complaints from the POTW.

I suggest you get a copy of the sewer ordinance. It's often useful to know precisely what's expected of your facility discharges.

Stormwater

IHP has an NPDES (National Pollution Discharge Elimination System) permit for stormwater releases. Their Stormwater Protection Program (SWPP) plan was prepared by a Professional Engineer registered in Tennessee. Appropriate annual sampling was conducted and properly reported to the Tennessee Department of Environment and Conservation, TDEC.

Air Emissions

Permits are in-hand for IHP's boilers, a baghouse collecting dust from a grinding operation, and for volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) emanating from electroplating line brightening baths. IHP recently had an outside consultant conduct a facility air

emission survey.

IHP's electroplating brightening operation has a "potential to emit" less than 5 tons of VOCs per year, hence is considered by TDEC to be an "area source." Brightener purchasing records are kept to verify usage.

RCRA Hazardous Wastes

IHP is a large quantity generator of Resource Conservation and Recovery Act (RCRA) hazardous wastes. They generate more than 2,200 pounds per month of F006 sludge from the wastewater pretreatment process. Manifests for transport and disposal of hazardous wastes are prepared, monitored, and kept as required. Annual hazardous waste reports are sent to TDEC.

IHP prepared a hazardous waste reduction plan (HWRP) as required to meet this state requirement for hazardous waste generators. The HWRP includes all required elements.

I did not review the HWRP in detail, but feel you may find relating hazardous waste generation to the specific reason for the waste being generated may lead to better control. As we discussed, counting pieces processed seldom truly measures why waste gets generated.

Used Oil

IHP discards a considerable amount of oil consisting primarily of synthetic fluids and lubricating oil from the company's many metal fabricating operations. It has had analyses conducted to demonstrate that the oil is not subject to 40 CFR part 261 when burned for energy recovery. Its "used oil" gets transported to an "on-specification" oil burning facility by a transporter with an EPA ID number.

Oil Storage

IHP stores above ground more than 1,320 gallons of fuel oil at its facility. Hence, the company is subject to duties required by spill prevention, containment, and control (SPCC) rules at 40 CFR 112. IHP has an SPCC plan; however, the plan was not prepared under the supervision of a professional engineer as required.

Generally, items already addressed by the professional-engineer-prepared stormwater pollution prevention plan will accommodate 40 CFR 112 requirements. I feel you should have the professional engineer who did your SWPP plan put the two plans together.

Special Wastes

IHP is fully cognizant of TDEC's special waste requirements and has secured appropriate permits.

Appendix E

Waste Stream Analysis

Waste	Yearly Quantities	Treatment
Scrap Metal		
Galvanized	1,800,000 lbs.	Metals Recovery
Hot Roll	1,800,000 lbs.	Metals Recovery
Brass Strip	1,900 lbs.	Metals Recovery
Brass Forgings	6,800 lbs.	Metals Recovery
Malleable Iron	182,000 lbs.	Metals Recovery
Tubing	36,800 lbs.	Metals Recovery
Stainless	2,900 lbs.	Metals Recovery
Aluminum	1,900 lbs.	Metals Recovery
Used Oil	24,600 Gal	Separation Oil & Water Fuel Blending
Used Oil & Oil Dri	7,830 lbs.	Burning
Drums - Plastic & Metal	280 pcs	Cleaning & Recycling
Paint Filters	1,943 pcs	Land Disposal
Paint Buckets	122 pcs	Land Disposal
Dust from Baghouse	6,840 lbs.	Metals Recovery
Waste Lacquer	98 gals	Burning
Empty Bags (Chemical Packaging)	1,600 pcs	Land Disposal
Sand from Sand Filter	1,850 lbs.	Stabilize-Land Disposal
Oil Dri & Absorbent Padding (Saturated)	990 lbs.	Burning
Wastewater Treatment Sludge (F006)	324,000 lbs.	Metal Recovery
Spent Acids and Alkaline Cleaners	18,900 gals	Neutralization & Treatment
Spill Clean-up Residues	1,990 lbs.	Neutralization & Treatment
Residue from Cleaning Parts Removed from Tanks	3,690 lbs.	Neutralization & Treatment
Spent Fluorescent Light Bulbs	760 lbs.	Recycling
Spent Batteries	6 pcs	Recycling
Spent Ballast	49 pcs	Recycling

Grinding Dust	1,800 lbs.	Stabilization & Land Disposal
Used Ion Exchange Resins	38 lbs.	Stabilization & Land Disposal
Grindings from Making Tooling		Metals Recovery
Water from EDM Machine	142 gals	Neutralization - POTW
Residue from Cleaning up Spills		Case by Case Basis
Scrap Pallets and Wooden Crates	2,870 yds^3	Land Disposal-Demolition Area
Package Material		Recycling Land Disposal
Cardboard		Recycling Land Disposal
Banding (Metal and Plastic)		Land Disposal Metals Recovery
Restroom and Cafeteria Garbage		Land Disposal
Paper		Land Disposal
Package Material		Land Disposal
Toner Cartridges		Land Disposal
Thermal Transfer Ribbon		Land Disposal
Plant Garbage	2,900 yds^3	
Medical Waste	89 lbs.	Incineration

Appendix F

International Chamber of Commerce

The Business Charter for Sustainable Development
Principles for Environmental Management

Fifth Anniversary Edition

Foreword

There is widespread recognition today that environmental protection must be among the highest priorities of every business.

In its milestone 1987 report, "Our Common Future," the World Commission on Environment and Development (Brundtland Commission) emphasized the importance of environmental protection to the pursuit of sustainable development.

To help business around the world improve its environmental performance, the International Chamber of Commerce created this Business Charter for Sustainable Development. It comprises sixteen Principles for environmental management which, for business, is a vitally important aspect of sustainable development.

This Charter assists enterprises in fulfilling their commitment to environmental stewardship in a comprehensive fashion, in line with national and international guidelines and standards for environmental management. It was formally launched in April 1991 at the Second World Industry Conference on Environmental Management in Rotterdam, and continues to be widely applied and recognized around the world.

Introduction

Sustainable development involves meeting the needs of the present without compromising the ability of future generations to meet their own needs. Economic growth provides the conditions in which protection of the environment can best be achieved, and environmental protection, in balance with other human goals, is necessary to achieve growth that is sustainable.

In turn, versatile, dynamic, responsive and profitable businesses are required as the driving force for sustainable economic development and for providing the managerial, technical and financial resources to contribute to the resolution of environmental challenges. Market economies, characterized by entrepreneurial initiatives, are essential to achieve this.

Business thus shares the view that there should be a common goal, not a conflict, between economic development and environmental protection, both now and for future generations.

Making market forces work in this way to protect and improve the quality of the environment -- with the help of standards such as ISO 14000, and judicious use of economic instruments in a harmonious regulatory framework is an on-going challenge that the world faces in entering the 21st century.

This challenge was recognized by the nations of the world at the 1992 United Nations Conference on Environment and Development, which called on the co-operation of business in tackling it. To this end, business leaders have launched initiatives in their individual enterprises as well as through sectoral and cross-sectoral associations.

In order that more businesses join this effort and that their environmental performance continues to improve, the International Chamber of Commerce continues to call upon enterprises and their associations to use the following

Principles as a basis for pursuing such improvement and to express publicly their support for them.

Individual programmes to implement these Principles will reflect the wide diversity among enterprises in size and function.

The objective remains that the widest range of enterprises commit themselves to improving their environmental performance in accordance with these Principles, to having in place management practices to effect such improvement, to measuring their progress, and to reporting this progress as appropriate internally and externally.

Principles

1. Corporate priority; To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programmes and practices for conducting operations in an environmentally sound manner.

2. Integrated management; To integrate these policies, programmes and practices fully into each business as an essential element of management in all its functions.

3. Process of improvement; To continue to improve corporate policies, programmes and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

4. Employee education; To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

5. Prior assessment; To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

6. Products and services; To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

7. Customer advice; To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided, and to apply similar considerations to the provision of services.

8. Facilities and operations; To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimization of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

9. Research; To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

10. Precautionary approach; To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. Contractors and suppliers; To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

12. Emergency preparedness; To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts

13. Transfer of technology; To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. Contributing to the common effort; To contribute to the development of public policy and to business, governmental and intergovernmental programmes and educational initiatives that will enhance environmental awareness and protection.

15. Openness to concerns; To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

16. Compliance and reporting; To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

Note: The term environment as used in this document also refers to environmentally related aspects of health, safety and product stewardship.

Support for the Charter

The ICC undertakes to encourage member companies and others to express their support and implement the Charter and its Principles. A list of these companies can be obtained from ICC Headquarters. The ICC also publishes regularly a Charter bulletin which provides more specific information on the Charter's Principles and different interpretations possible - an attribute of the Charter that has been widely commended.

The first edition of Business Charter for Sustainable Development was adopted by the ICC Executive Board on 27 November 1990, and first published in April 1991. It was prepared and revised by the ICC Working Party for Sustainable Development.

Chairman: Peter Scupholme (British Petroleum) Vice-Chairman: W. Ross Stevens III (Du Pont). The ICC is indebted to numerous companies and business organizations for their input in preparing and revising the Charter. For further information, contact Oliver Keserue, Project Manager at ICC Headquarters, Paris.

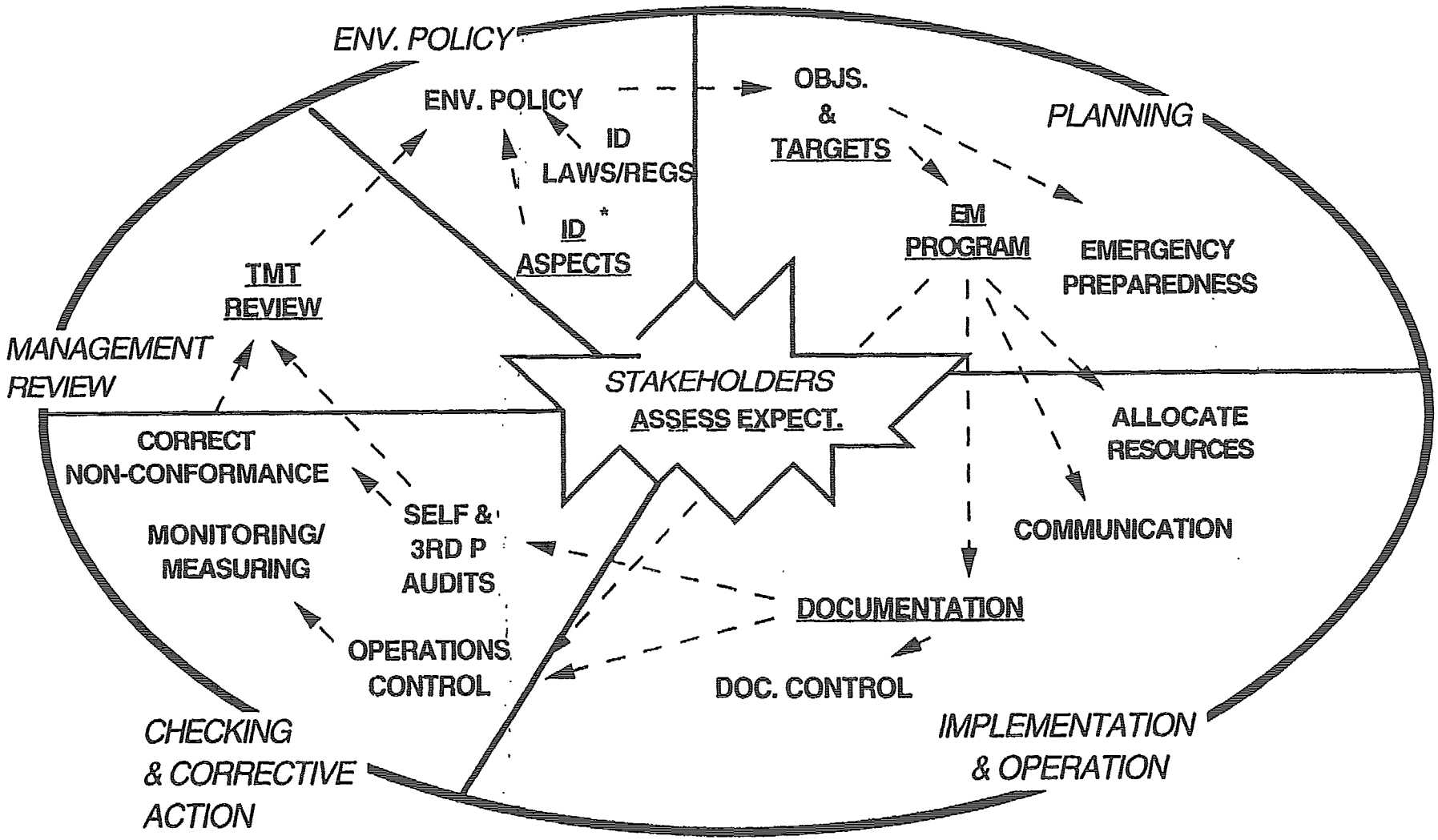
The Business Charter for Sustainable Development provides a basic framework of reference for action by individual corporations and business organizations throughout the world. It has been recognized as a complement to environmental management systems. To this end, the ICC, the United Nations Environment Programme (UNEP) and the International Federation of Consulting Engineers (FIDIC) have developed a kit to help enterprises integrate environmental management systems in the daily management practices, a step consistent with the objectives set out in this Charter.

The Business Charter has been published in over 20 languages, including all the official languages of the United Nations.

WHY IEH-TENNESSEE MAY WANT ISO 14000 CERTIFICATION?

PROS	CONS
CUSTOMER REQUIREMENTS OR PREFERENCES -- ATTITUDES OF KEY CUSTOMERS -- TYPE OF CUSTOMERS -- INTERNATIONAL SALES -- INTERNAL SALES	COST OF EXTERNAL CONSULTANTS
COST SAVINGS -- AVOIDED LITIGATION -- RECYCLE & REUSE -- SAFE SUBSTITUTES -- LESS INSPECTION -- LOWER INSURANCE RATES	INTERNAL COSTS -- DOCUMENTATION -- TRAINING -- OTHER TIME SPENT
EXECUTIVE PROTECTION -- EMERGENCY READINESS --REDUCTION IN PENALTY	OPPORTUNITY COSTS -- SMEs
IMPROVED ENVIRONMENTAL PERFORMANCE -- PRIORITIZATION -- GOOD PRACTICES -- CROSS FUNC. INTEGRATION	CONCERNS ABOUT REGISTRATION -- CONSISTENCY -- COMPETENCE -- RECOGNITION
LEADERSHIP -- FIRST MOVER -- TYPE OF INDUSTRY -- TYPE OF CUSTOMER	

WHAT DOES IEH NEED TO DO?



* LACKING ACCORDING TO GAP ANALYSIS

Environmental Policy Statements

Thomas J. Dean
Associate Professor of Management
University of Tennessee

Purpose and Nature of Environmental Policies

- Purpose
  - Externally;
    - Reflect image and intent to community, employees, suppliers and regulators
  - Internally;
    - Codify commitment
    - Drive strategic and operational decision-making
- Nature
  - "An organization should first focus on what needs to be done-it should ensure commitment to environmental management and define its policy."
  - A "statement by the organization of its intentions and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its environmental objectives and targets."

ISO 14001 Requirements

- Standard requires that the policy;
  - a) be appropriate to the nature, scale and environmental impacts of the organization's activities, products, and services;
  - b) include a commitment to continual improvement and prevention of pollution;
  - c) include a commitment to comply with relevant environmental legislation and regulation, and to other requirements to which the organization subscribes.
  - d) be made available to the public

Format Issues in Drafting a Policy

- Length
- Breadth
  - Policy versus operational procedures
  - Policy versus goals or objectives
  - General versus specific commitments
- Structure
  - Single paragraph
  - Generic statement followed by set of principles
  - Multiple paragraphs
- Reference to organizational mission
- Fit with other policy formats

Environmental Policy Dimensions

- Sustainable Development; to conduct business in a manner consistent with the principle of sustainable development.
- Environmental Leadership; to lead the industry in addressing environmental issues.
- Stakeholder Orientation; to recognize the environmental needs and desires of relevant stakeholder groups and address those needs and desires whenever practical.
- Integration; to integrate environmental considerations into other functional activities and into top management decision-making.
- Compliance; to comply with or exceed all relevant legislation and regulation.
- Environmental Performance; to minimize the environmental impact of the company's products and services. Possibly divided into the mediums of air, water and land, or specific to particular environmental problems (i.e. greenhouse gases).
- Pollution Prevention; to utilize the techniques of pollution prevention.
- Recycling or Reuse; to minimize waste through recycling or reuse.
- Energy Conservation; to efficiently use energy and reduce the use of energy.
- Resource Conservation; to efficiently use resources and reduce the use of resources.

Environmental Policy Dimensions

- Habitat Enhancement; to manage land to enhance the habitat for wildlife.
- Zero Waste and Emissions; to drive towards zero waste generation and emissions.
- Continual Improvement; to continually improve environmental performance.
- EMS Continual Improvement; to continually improve the environmental management system.
- Training and Awareness; to train all employees in relevant environmental issues.
- Measurement; to develop and maintain environmental performance measures.
- Reporting; to report environmental performance to external constituencies.
- Life Cycle Thinking; to minimize environmental impacts beyond the boundaries of the organization.
- Supplier Preference; to give preference to suppliers and contractors who have demonstrated environmentally responsible products, services, and management.
- Supplier and Customer Assistance; to assist suppliers and customers in improving their environmental performance
- Research & Development; to develop technological solutions to environmental problems.

Procter & Gamble

Procter & Gamble continually strives to improve the environmental quality of its products, packaging, and operations around the world. To carry out this commitment it is Procter & Gamble's policy to:

- Ensure our products, packaging, and operations are safe for our employees, consumers, and the environment.
- Reduce or prevent the environmental impact of our products and packaging in their design, manufacture, distribution, use, and disposal, whenever possible.
- Meet or exceed the requirements of all environmental laws and regulations.
- Continually assess our environmental technology and programs, and monitor progress toward environmental goals.

Bristol-Myers Squibb Environmental, Health, and Safety Policy

- It is the policy of Bristol-Myers Squibb to protect the health, safety, and quality of life of its employees, customers, and the public, and to conduct all of its activities in an environmentally sustainable manner which takes into consideration the integrity of natural systems--i.e., land, water, air, and biodiversity.
- Bristol-Myers Squibb will strive to continuously improve its environmental, health, and safety (EHS) performance by minimizing and, where feasible, eliminating negative EHS impacts associated with its facilities, activities, and products. Management will ensure that every employee understands the importance of and is responsible and accountable for, integrating EHS considerations into their daily responsibilities.
- Bristol-Myers Squibb, its divisions, and business functions will consider the EHS concerns of stakeholders, and work in an integrated manner to identify, evaluate, and resolve EHS impacts related to the management of resources and their related byproducts--i.e., selection, use, and exposure.
- To the extent feasible, Bristol-Myers Squibb will give preference to suppliers and contractors whose EHS commitment and practices are consistent with its own, and who have demonstrated environmentally-responsible products, services, and management.
- Bristol-Myers Squibb, its divisions and business functions will develop and maintain EHS performance measures, conduct regular performance evaluations, and report findings to internal and external stakeholders.
- Compliance with all relevant government requirements and company policies and guidelines will be the minimum acceptable level of performance for the Company's divisions, business functions, and employees.

Environmental Aspects, Objectives, and Targets

Thomas J. Dean
Associate Professor of Management
University of Tennessee

ISO 14001 Requirements

The organization shall establish and maintain a procedure to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment. The organization shall ensure that the aspects related to these significant impacts are considered in setting its environmental objectives.

The organization shall establish and maintain a procedure to identify and have access to legal and other requirements to which the organization subscribes, that are applicable to environmental aspects of its activities, products, or services.

The organization shall establish and maintain documented environmental objectives and targets at each relevant function and level within the organization.

ISO EMS Definitions

- Environmental Performance; Measurable outputs of the environmental management system, relating the organization's control of the impact of its activities,products, and services on the environment, based on its environmental policy, objectives, and targets.
- Environmental Objectives; Overall environmental goals, arising from the environmental policy and significant impacts, that an organization sets itself to achieve, and which are quantified wherever practicable.
- Environmental Target; Detailed performance requirement, quantified wherever practicable, applicable to the organization or parts thereof, that arise from the environmental objectives and that need to be set and met in order to achieve those objectives.
- Environmental Policy; Statement by the Organization of its intention and principles in relation to its overall environmental performance which provides a framework for action and for the setting of its environmental objectives and targets.

Aspects versus Impacts

- Activity; Handling of hazardous materials
  - Aspect; potential for accidental spillage
  - Impact; contamination of soil or water
- Activity; Vehicle maintenance
  - Aspect; exhaust emissions
  - Impact; reduction of air pollution

Evaluating the Significance of Environmental Aspects

- The scale of the impact
- The severity of the impact
- The probability of occurrence
- The duration of impact
- Primary and secondary impacts
- Regulatory relevance

Practical Help **Identification of Environmental Aspects and Evaluation of Associated Environmental Impacts**

This s a procedure that can be dealt with in four stages.

Step 1 Select an Activity or Process

The selected activity or process should be large enough for meaningful examination and small enough to be sufficiently understood.

Example: Product Design

Step 2 Identify Environmental Aspects of the Activity or Process

Identify as many environmental aspects as possible associated with the selected activity or process.

Example: Product Design can have the following aspects:

- packaging
- raw materials
- processing energy
- etc.

Step 4 Evaluate Significance of Impacts

The significance of each of the identified environmental impacts can be different for each organisation. Quantification can aid judgement.

Evaluation can be facilitated by considering:

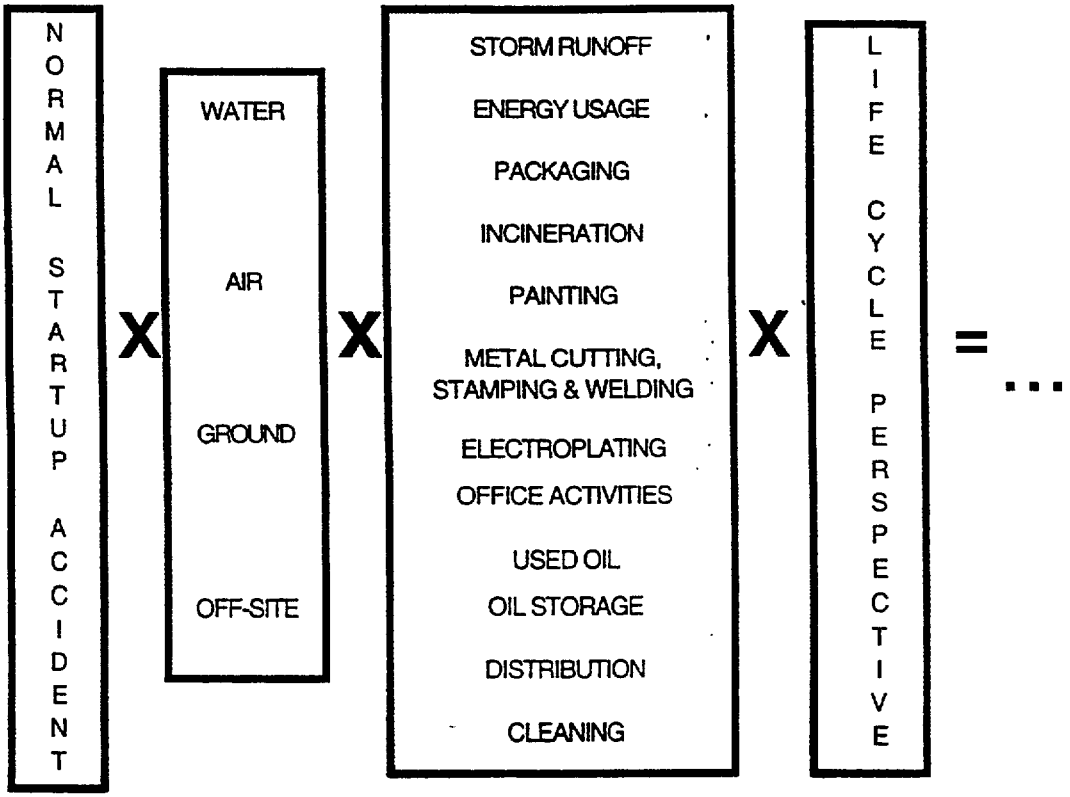
Environmental Concerns:

- the scale of the impact
- the severity of the impact
- probability of occurrence
- permanence of impact

Business Concerns:

- potential regulatory and legal exposure
- difficulty of changing the impact
- cost of changing the impact
- effect of change on other activities and processes
- concerns of interested parties
- effect on the public image of the organisation

WHAT ENVIRONMENTAL ASPECTS WOULD IEH-T IDENTIFY?



Setting Goals and Benchmarks; Some Considerations

1. Environmental Policy
2. Significant Environmental Aspects
3. Potential Cost Savings
4. Cost of Improvement
5. External Constituencies
6. Measurability
7. Regulatory Requirements

Practical Help **Environmental Management Plans and Program**

Example of Objectives and Targets Linked in Environmental Management Plans and Program

Policy: To conserve natural resources.

Objective: To minimise the use of water wherever technologically and commercially viable.

Target: To reduce water consumption by 15% of present levels within one year.

Such a target would in turn have to be translated into a number of action plans, including for example:

Action plan: Install equipment to recycle rinse water for Process A for re-use in Process B which does not require water of the same high quality.

Person responsible: John Waters

Resources: existing operations staff
new water recycling technology
100K from capital budget

Completion Date: November X, 19XX.

REGISTRAR SELECTION IS CRITICAL

Accreditation & experience in SIC

International Visibility
- -- Reputation
- -- Acceptance

Ability to joint register to 9000 & 14000

Rigor (depends on goals)

Consistency (depends largely on personnel)

Certification Preferences

IEH-TENNESSEE CASE
EPILOG

AS OF MAY, 1997 IEH OF TENNESSEE HAD YET TO FULLY COMMIT TO DEVELOPING AN ISO 14001 EMS. IT SEEMS THAT THE FACILITY MANAGER AND CORPORATE WERE CONCERNED WITH THE COSTS AND DID NOT SEE ENOUGH IMMEDIATE, CONCRETE BENEFITS FROM CERTIFICATION. PERHAPS MOST IMPORTANTLY, RICK THOMPSON (WHO WAS CHAMPIONING THE INITIATIVE) WAS TRANSFERRED TO ANOTHER IEH FACILITY. THE NEW QUALITY ASSURANCE HEAD WAS INTERESTED IN THE STANDARD, BUT LESS MOTIVATED TO PURSUE IT. HE DID, HOWEVER, ATTEND A COUPLE OF SEMINARS AND WORKSHOPS ON ISO 14001. ESSENTIALLY, THE FACILITY WAS TAKING A 'WAIT AND SEE' APPROACH. CORPORATE WAS REPORTEDLY CONTINUING TO MONITOR ACCEPTANCE OF THE STANDARD, BUT WAS PREOCCUPIED WITH AN AGGRESSIVE ACQUISITION STRATEGY.

MEANWHILE, PHLLIPS NORTH AMERICAN BECAME THE FIRST TENNESSEE FACILITY CERTIFIED (BUT THE PLANT WAS SOLD SHORTLY THEREAFTER). GENERALLY, FIRMS IN THE EU WERE MOVING RAPIDLY TO IMPLEMENT THE STANDARD, AND THE MINISTRY FOR INTERNATIONAL TRADE AND INDUSTRY IN JAPAN WAS ASKING MAJOR MANUFACTURERS THERE TO PURSUE CERTIFICATION. U.S. INDUSTRY, BY COMPARISON, WERE, LIKE IEH, WAITING FOR MORE CONCRETE EVIDENCE OF A PAYBACK.

OVERVIEW OF ISO 14001

- DRAMATICALLY DIFFERENT APPROACH THAN VIA REGULATION (CONSIDER IN CONTEXT OF COMMONS GAME)
- ADDRESSES CONTEMPORARY NEED GIVEN GLOBAL ECONOMY AND EXTENT OF ENV. PROBLEMS
- REFLECTIVE OF MANAGEMENT'S DESIRE TO TAKE BACK SOME CONTROL OF PROCESS
- EMPHASIS ON PRAGMATISM AND FLEXIBILITY
- PART OF LARGER SHIFT AWAY FROM STRICT CUSTOMER/ MARKET CONTROL MODEL OF BUSINESS (MARX)
- WILL IT WORK?
  - INTERNATIONAL ACCEPTANCE
  - ACCEPTED AS SUBSTITUTE FOR TOUGHER STDS. (EMAS, BS7750)
  - FIT WITH INDUSTRY INITIATIVES (RESPONSIBLE CARE)
  - SUPPLIER REQUIREMENTS BY POWERFUL CUSTOMERS
  - CREDIBILITY OF AUDITING AND CERTIFICATION
  - ANECDOTAL EVIDENCE OF RETURN
  - RESPONSE OF GOVTS. AND INSURANCE INDUSTRY
- WHAT MORE NEEDS TO BE DONE?
  - ADAPT TO SMES (70% OF WORLD'S ECONOMY IS FED BY CO. WITH FEWER THAN 200)
  - ADAPT TO SPECIFIC INDUSTRIES???

LESSONS FROM IEH-TENNESSEE CASE DISCUSSION

- TO PROVIDE A CONTEXT FOR UNDERSTANDING ISO 14000 AND WHY A COMPANY WOULD WANT CERTIFICATION.
- TO SEE VOLUNTARY CONSENSUS STANDARDS AS ONE MORE APPROACH TO PRESERVING COMMON RESOURCES AND TO UNDERSTAND WHY THEY WORK.
- TO SEE ISO 14000 AS PART OF AN EVOLVING RELATIONSHIP BETWEEN BUSINESS AND SOCIETY IN RESPONSE TO CONCERNS WITH BOTH MANAGERIAL PREROGATIVES AND MORE ENVIRONMENTAL REGULATION
- TO UNDERSTAND HOW ISO 14000 MAY BE A WIN/WIN APPROACH FOR VARIOUS STAKEHOLDERS.
- TO APPRECIATE THE LARGE NUMBER OF ENVIRONMENTAL ASPECTS IN A RELATIVELY SIMPLE BUSINESS.

February 17, 1998

Module III

Pollution prevention--"The Fun Factory"

PARTICPANT'S MANUAL

The Fun Factory

Training in Waste Reduction Using a Mock Industrial Process

BACKROUND

Your division, part of a giant defense contracting corporation, lost its only significant contract 14 months ago in a surprise policy reversal by the Government. Since then the division has been downsizing while it desperately seeks a new contract. Specifically, your division, and every other firm in your former industry, is competing in the proof of concept/proof of capability phase of what promises to be a major new Government contract. As part of its new sole sourcing strategy, the Government plans to award the entire contract to the supplier who wins the competition. Success will be based upon the speed of production ramp up, delivery times for new products, quality of products, rejection rates, ability to quickly respond to rush orders, scrap, environmental compliance, and levels of hazardous waste materials generated.

DIVISION'S POSITIONS AND JOB DESCRIPTIONS

VP of Marketing - In charge of finding new contracts. Career suffered a direct hit when the VP was surprised by the Governmental reversal of policy and the cutting of former contract. Figures (and rightly so) that promotion to the corporate level rides on getting this new contract. Firm believer in TQM.

Plant Engineer - In charge of handling the drums, preparing the Play-Doh material for use in the machine, worker complaints, and the company Christmas party.

Storage Shed Manager - Inventory control over wastes - proper labeling, proper storage, and reports quantity of wastes to Plant Engineer (reports are generally 3-4 months behind production).

Line Operator - Extrudes the products as ordered, cleans up the machinery. Minimum wage (plus $.10 per hour premium due to seniority). Glad to have the Job.

Regulatory Compliance Coordinator - Monitors the entire operation for environmental safety, and solid waste compliance. B.S. Chemistry, M.S. Environmental Engineering, C.S.P. (Certified Safety Professional), C.H.W.T. (Certified Hazardous Waste Trainer).

GOVERNMENT POSITIONS

Governmental EH&S Compliance Inspector - Monitors manufacturers for violation of environmental, safety, and health violations. Has complete access to all production facilities. Has the right to reclassify any improperly produced goods from non-hazardous to hazardous classification. Faces serious consequences if press discovers noncompliant behavior before the inspector does.

Governmental Vendor Relations Officer - Former purchasing agent who received a promotion to VRO without a raise. Would like to run things by the book. Very particular about product dimensions, smooth aerodynamic surfaces on all products, and supplier's ability to deliver all products fast - ESPECIALLY rush orders.

COMPANY POLICIES

1. QUALITY is everyone's responsibility. Objections by anyone to the appearance, performance, or condition of any product makes the part a "REJECT".

2. SAFETY is vital to the economic feasibility of staying in business. Unsafe acts will result in corrective counseling. Repeated unsafe acts may result in discharge.

RULES

1. This is a military specifications job; while the material is in the hands of the Plant Engineer, it may be kneaded, rolled, and worked. Once it is placed in the machine, it becomes either product or waste - THERE IS NO RECYCLING OR REUSE OF MATERIAL!

2. Yellow Play-Doh is non-hazardous. Blue Play-Doh is VERY hazardous and the third color of dough is mildly hazardous. Any mixing of colors, no matter how trivial, results in hazardous waste. (Government Inspectors and VRO's are real sticklers on this).

3. JIT production requires that all work must be scheduled according to the sequence of customer orders.

INSTRUCTIONS TO PARTICIPANTS

1. Set up materials to each facility, have employees decide on which position each will assume. (allocate dual roles if you run short of players).

2. Once the Customer orders are received and understood, begin production.

3. Waste will be accumulated in the Storage Shed. Separate waste by color and type of waste. Waste will be either Quality Control Waste, Process Waste, or Clean-Up Waste. Quality Control Waste is defined as any product rejected by an employee from either your division or the Government. Process Waste is waste generated in the start-up or end-of-run material. Each time production is completed, any material left in the machine will be pushed through and declared Process Waste. Clean-up Waste is any material removed from the machine during the preparation for a color change.

4. Remember, you are in competition with the other companies for selection as the sole source supplier under the new contract. (Please review selection criteria listed in background). Winning this contract would save your division.

5. Once you have completed production of all parts, form a Quality Circle to discuss your wastes and the improvements you made, or could make during future production runs.

Quality Control is

Everyone's Responsibility

- **Make 3 Yellow Stars**

  (Non hazardous width of lid)

- **Make 3 I-Beams - Third Color**

  (Somewhat hazardous,

  width = diameter of Play-Doh lid)

- **Make 6 Blue Ropes**

  (Make 3 at a time)

  (Very Hazardous, Length of

  Play-Doh can without lid)

Separate Wastes by Color and Type:

---

1. Quality Control Waste

2. Process Waste

3. Clean Up Waste

	Q.C. Waste	Process Waste	Clean-up Waste
Yellow			
Third Color			
Blue			

Conclusions

Good management controls complexity; effective leadership produces useful change.

What Leaders Really Do

by John P. Kotter

Leadership is different from management, but not for the reasons most people think. Leadership isn't mystical and mysterious. It has nothing to do with having "charisma" or other exotic personality traits. It is not the province of a chosen few. Nor is leadership necessarily better than management or a replacement for it.

Rather, leadership and management are two distinctive and complementary systems of action. Each has its own function and characteristic activities. Both are necessary for success in an increasingly complex and volatile business environment.

Most U.S. corporations today are overmanaged and underled. They need to develop their capacity to exercise leadership. Successful corporations don't wait for leaders to come along. They actively seek out people with leadership potential and expose them to career experiences designed to develop that potential. Indeed, with careful selection, nurturing, and encouragement, dozens of people can play important leadership roles in a business organization.

> Leadership complements management; it doesn't replace it.

But while improving their ability to lead, companies should remember that strong leadership with weak management is no better, and is sometimes actually worse, than the reverse. The real challenge is to combine strong leadership and strong management and use each to balance the other.

Of course, not everyone can be good at both leading and managing. Some people have the capacity to become excellent managers but not strong leaders. Others have great leadership potential but, for a variety of

John P. Kotter is professor of organizational behavior at the Harvard Business School and the author of The General Managers *(Free Press, 1982),* Power and Influence *(Free Press, 1985), and* The Leadership Factor *(Free Press, 1988). His most recent book is* A Force for Change: How Leadership Differs from Management *(Free Press, 1990).*

reasons, have great difficulty becoming strong managers. Smart companies value both kinds of people and work hard to make them a part of the team.

But when it comes to preparing people for executive jobs, such companies rightly ignore the recent literature that says people cannot manage *and* lead. They try to develop leader-managers. Once companies understand the fundamental difference between leadership and management, they can begin to groom their top people to provide both.

The Difference Between Management and Leadership

Management is about coping with complexity. Its practices and procedures are largely a response to one of the most significant developments of the twentieth century: the emergence of large organizations. Without good management, complex enterprises tend to become chaotic in ways that threaten their very existence. Good management brings a degree of order and consistency to key dimensions like the quality and profitability of products.

Leadership, by contrast, is about coping with change. Part of the reason it has become so important in recent years is that the business world has become more competitive and more volatile. Faster technological change, greater international competition, the deregulation of markets, overcapacity in capital-intensive industries, an unstable oil cartel, raiders with junk bonds, and the changing demographics of the work force are among the many factors that have contributed to this shift. The net result is that doing what was done yesterday, or doing it 5% better, is no longer a formula for success. Major changes are more and more necessary to survive and compete effectively in this new environment. More change always demands more leadership.

Consider a simple military analogy: a peacetime army can usually survive with good administration and management up and down the hierarchy, coupled with good leadership concentrated at the very top. A wartime army, however, needs competent leadership at all levels. No one yet has figured out how to manage people effectively into battle; they must be *led*.

These different functions—coping with complexity and coping with change—shape the characteristic activities of management and leadership. Each system of action involves deciding what needs to be done, creating networks of people and relationships that can accomplish an agenda, and then trying to ensure that those people actually do the job. But each accomplishes these three tasks in different ways.

Companies manage complexity first by *planning and budgeting*—setting targets or goals for the future (typically for the next month or year), establishing detailed steps for achieving those targets, and then allocating resources to accomplish those plans. By contrast, leading an organization to constructive change begins by *setting a direction*—developing a vision of the future (often the distant future) along with strategies for producing the changes needed to achieve that vision.

Management develops the capacity to achieve its plan by *organizing and staffing*—creating an organizational structure and set of jobs for accomplishing plan requirements, staffing the jobs with qualified individuals, communicating the plan to those people, delegating responsibility for carrying out the plan, and devising systems to monitor implementation. The equivalent leadership activity, however, is *aligning people*. This means communicating the new direction to those who can create coalitions that understand the vision and are committed to its achievement.

Finally, management ensures plan accomplishment by *controlling and problem solving*—monitoring results versus the plan in some detail, both formally and informally, by means of reports, meetings, and other tools; identifying deviations; and then planning and organizing to solve the problems. But for leadership, achieving a vision requires *motivating and inspiring*—keeping people moving in the right direction, despite major obstacles to change, by appealing to basic but often untapped human needs, values, and emotions.

A closer examination of each of these activities will help clarify the skills leaders need.

Setting a Direction vs. Planning and Budgeting

Since the function of leadership is to produce change, setting the direction of that change is fundamental to leadership.

Setting direction is never the same as planning or even long-term planning, although people often confuse the two. Planning is a management process, deductive in nature and designed to produce orderly results, not change. Setting a direction is more inductive. Leaders gather a broad range of data and look for patterns, relationships, and linkages that help explain things. What's more, the direction-setting aspect of leadership does not produce plans; it creates vision and strategies. These describe a business, technology, or corporate culture in terms of what it

should become over the long term and articulate a feasible way of achieving this goal.

Most discussions of vision have a tendency to degenerate into the mystical. The implication is that a vision is something mysterious that mere mortals, even talented ones, could never hope to have. But developing good business direction isn't magic. It is a tough, sometimes exhausting process of gathering and analyzing information. People who articulate such visions aren't magicians but broad-based strategic thinkers who are willing to take risks.

Nor do visions and strategies have to be brilliantly innovative; in fact, some of the best are not. Effective business visions regularly have an almost mundane quality, usually consisting of ideas that are already well known. The particular combination or patterning of the ideas may be new, but sometimes even that is not the case.

For example, when CEO Jan Carlzon articulated his vision to make Scandinavian Airline Systems (SAS) the best airline in the world for the frequent business traveler, he was not saying anything that everyone in the airline industry didn't already know. Business travelers fly more consistently than other market segments and are generally willing to pay higher fares. Thus focusing on business customers offers an airline the possibility of high margins, steady business, and considerable growth. But in an industry known more for bureaucracy than vision, no company had ever put these simple ideas together and dedicated itself to implementing them. SAS did, and it worked.

What's crucial about a vision is not its originality but how well it serves the interests of important constituencies—customers, stockholders, employees—and how easily it can be translated into a realistic competitive strategy. Bad visions tend to ignore the legitimate needs and rights of important constituencies—favoring, say, employees over customers or stockholders. Or they are strategically unsound. When a company that has never been better than a weak competitor in an industry suddenly starts talking about becoming number one, that is a pipe dream, not a vision.

One of the most frequent mistakes that overmanaged and underled corporations make is to embrace "long-term planning" as a panacea for their lack of direction and inability to adapt to an increasingly competitive and dynamic business environment. But such an approach misinterprets the nature of direction setting and can never work.

Long-term planning is always time consuming. Whenever something unexpected happens, plans have to be redone. In a dynamic business environment, the unexpected often becomes the norm, and long-term planning can become an extraordinarily burdensome activity. This is why most successful corporations limit the time frame of their planning activities. Indeed, some even consider "long-term planning" a contradiction in terms.

In a company without direction, even short-term planning can become a black hole capable of absorbing an infinite amount of time and energy. With no vision and strategy to provide constraints around the planning process or to guide it, every eventuality deserves a plan. Under these circumstances, contingency planning can go on forever, draining time and attention from far more essential activities, yet without ever providing the clear sense of direction that a company desperately needs. After awhile, managers inevitably become cynical about all this, and the planning process can degenerate into a highly politicized game.

Planning works best not as a substitute for direction setting but as a complement to it. A competent planning process serves as a useful reality check on direction-setting activities. Likewise, a competent direction-setting process provides a focus in which planning can then be realistically carried out. It helps clarify what kind of planning is essential and what kind is irrelevant.

Aligning People vs. Organizing and Staffing

A central feature of modern organizations is interdependence, where no one has complete autonomy, where most employees are tied to many others by their work, technology, management systems, and hierarchy. These linkages present a special challenge when organizations attempt to change. Unless many individuals line up and move together in the same direction, people will tend to fall all over one another. To executives who are overeducated in management and undereducated in leadership, the idea of getting people moving in the same direction appears to be an organizational problem. What executives need to do, however, is not organize people but align them.

Managers "organize" to create human systems that can implement plans as precisely and efficiently as possible. Typically, this requires a number of potentially complex decisions. A company must choose a structure of jobs and reporting relationships, staff it with individuals suited to the jobs, provide training for those who need it, communicate plans to the work force, and decide how much authority to delegate and to whom. Economic incentives also need to be constructed to accomplish the

plan, as well as systems to monitor its implementation. These organizational judgments are much like architectural decisions. It's a question of fit within a particular context.

Aligning is different. It is more of a communications challenge than a design problem. First, aligning invariably involves talking to many more individuals than organizing does. The target population can involve not only a manager's subordinates but also bosses, peers, staff in other parts of the organization, as well as suppliers, governmental officials, or even customers. Anyone who can help implement the vision and strategies or who can block implementation is relevant.

Trying to get people to comprehend a vision of an alternative future is also a communications challenge of a completely different magnitude from organizing them to fulfill a short-term plan. It's much like the difference between a football quarterback attempting to describe to his team the next two or three plays versus his trying to explain to them a totally new approach to the game to be used in the second half of the season.

Whether delivered with many words or a few carefully chosen symbols, such messages are not necessarily accepted just because they are understood. Another big challenge in leadership efforts is credibility—getting people to believe the message. Many things contribute to credibility: the track record of the person delivering the message, the content of the message itself, the communicator's reputation for integrity and trustworthiness, and the consistency between words and deeds.

Finally, aligning leads to empowerment in a way that organizing rarely does. One of the reasons some organizations have difficulty adjusting to rapid changes in markets or technology is that so many people in those companies feel relatively powerless. They have learned from experience that even if they correctly perceive important external changes and then initiate appropriate actions, they are vulnerable to someone higher up who does not like what they have done. Reprimands can take many different forms: "That's against policy" or "We can't afford it" or "Shut up and do as you're told."

> Management controls people by pushing them in the right direction; leadership motivates them by satisfying basic human needs.

Alignment helps overcome this problem by empowering people in at least two ways. First, when a clear sense of direction has been communicated throughout an organization, lower level employees can initiate actions without the same degree of vulnerability. As long as their behavior is consistent with the vision, superiors will have more difficulty reprimanding them. Second, because everyone is aiming at the same target, the probability is less that one person's initiative will be stalled when it comes into conflict with someone else's.

Motivating People vs. Controlling and Problem Solving

Since change is the function of leadership, being able to generate highly energized behavior is important for coping with the inevitable barriers to change. Just as direction setting identifies an appropriate path for movement and just as effective alignment gets people moving down that path, successful motivation ensures that they will have the energy to overcome obstacles.

According to the logic of management, control mechanisms compare system behavior with the plan and take action when a deviation is detected. In a well-managed factory, for example, this means the planning process establishes sensible quality targets, the organizing process builds an organization that can achieve those targets, and a control process makes sure that quality lapses are spotted immediately, not in 30 or 60 days, and corrected.

For some of the same reasons that control is so central to management, highly motivated or inspired behavior is almost irrelevant. Managerial processes must be as close as possible to fail-safe and risk-free. That means they cannot be dependent on the unusual or hard to obtain. The whole purpose of systems and structures is to help normal people who behave in normal ways to complete routine jobs successfully, day after day. It's not exciting or glamorous. But that's management.

Leadership is different. Achieving grand visions always requires an occasional burst of energy. Motivation and inspiration energize people, not by pushing them in the right direction as control mechanisms do but by satisfying basic human needs for achievement, a sense of belonging, recognition, self-esteem, a feeling of control over one's life, and the ability to live up to one's ideals. Such feelings touch us deeply and elicit a powerful response.

Good leaders motivate people in a variety of ways. First, they always articulate the organization's vision

in a manner that stresses the values of the audience they are addressing. This makes the work important to those individuals. Leaders also regularly involve people in deciding how to achieve the organization's vision (or the part most relevant to a particular individual). This gives people a sense of control. Another important motivational technique is to support employee efforts to realize the vision by providing coaching, feedback, and role modeling, thereby helping people grow professionally and enhancing their self-esteem. Finally, good leaders recognize and reward success, which not only gives people a sense of accomplishment but also makes them feel like they belong to an organization that cares about them. When all this is done, the work itself becomes intrinsically motivating.

The more that change characterizes the business environment, the more that leaders must motivate people to provide leadership as well. When this works, it tends to reproduce leadership across the entire organization, with people occupying multiple leadership roles throughout the hierarchy. This is highly valuable, because coping with change in any complex business demands initiatives from a multitude of people. Nothing less will work.

Of course, leadership from many sources does not necessarily converge. To the contrary, it can easily conflict. For multiple leadership roles to work together, people's actions must be carefully coordinated by mechanisms that differ from those coordinating traditional management roles.

Strong networks of informal relationships – the kind found in companies with healthy cultures – help coordinate leadership activities in much the same way that formal structure coordinates managerial activities. The key difference is that informal networks can deal with the greater demands for coordination associated with nonroutine activities and change: The multitude of communication channels and the trust among the individuals connected by those channels allow for an ongoing process of accommodation and adaptation. When conflicts arise among roles, those same relationships help resolve the conflicts. Perhaps most important, this process of dialogue and accommodation can produce visions that are linked and compatible instead of remote and competitive. All this requires a great deal more communication than is needed to coordinate managerial roles, but unlike formal structure, strong informal networks can handle it.

> Despite leadership's growing importance, the on-the-job experiences of most people undermine their ability to lead.

Of course, informal relations of some sort exist in all corporations. But too often these networks are either very weak – some people are well connected but most are not – or they are highly fragmented – a strong network exists inside the marketing group and inside R&D but not across the two departments. Such networks do not support multiple leadership initiatives well. In fact, extensive informal networks are so important that if they do not exist, creating them has to be the focus of activity early in a major leadership initiative.

Creating a Culture of Leadership

Despite the increasing importance of leadership to business success, the on-the-job experiences of most people actually seem to undermine the development of attributes needed for leadership. Nevertheless, some companies have consistently demonstrated an ability to develop people into outstanding leader-managers. Recruiting people with leadership potential is only the first step. Equally important is managing their career patterns. Individuals who are effective in large leadership roles often share a number of career experiences.

Perhaps the most typical and most important is significant challenge early in a career. Leaders almost always have had opportunities during their twenties and thirties to actually try to lead, to take a risk, and to learn from both triumphs and failures. Such learning seems essential in developing a wide range of leadership skills and perspectives. It also teaches people something about both the difficulty of leadership and its potential for producing change.

Later in their careers, something equally important happens that has to do with broadening. People who provide effective leadership in important jobs always have a chance, before they get into those jobs, to grow beyond the narrow base that characterizes most managerial careers. This is usually the result of lateral career moves or of early promotions to unusually broad job assignments. Sometimes other vehicles help, like special task-force assignments or a lengthy general management course. Whatever the case, the breadth of knowledge developed in this way seems to be helpful in all aspects of leadership. So does the network of relationships that is often acquired both inside and outside the company. When

enough people get opportunities like this, the relationships that are built also help create the strong informal networks needed to support multiple leadership initiatives.

> One way to develop leadership is to create challenging opportunities for young employees.

Corporations that do a better-than-average job of developing leaders put an emphasis on creating challenging opportunities for relatively young employees. In many businesses, decentralization is the key. By definition, it pushes responsibility lower in an organization and in the process creates more challenging jobs at lower levels. Johnson & Johnson, 3M, Hewlett-Packard, General Electric, and many other well-known companies have used that approach quite successfully. Some of those same companies also create as many small units as possible so there are a lot of challenging lower level general management jobs available.

Sometimes these businesses develop additional challenging opportunities by stressing growth through new products or services. Over the years, 3M has had a policy that at least 25% of its revenue should come from products introduced within the last five years. That encourages small new ventures, which in turn offer hundreds of opportunities to test and stretch young people with leadership potential.

Such practices can, almost by themselves, prepare people for small- and medium-sized leadership jobs. But developing people for important leadership positions requires more work on the part of senior executives, often over a long period of time. That work begins with efforts to spot people with great leadership potential early in their careers and to identify what will be needed to stretch and develop them.

Again, there is nothing magic about this process. The methods successful companies use are surprisingly straightforward. They go out of their way to make young employees and people at lower levels in their organizations visible to senior management. Senior managers then judge for themselves who has potential and what the development needs of those people are. Executives also discuss their tentative conclusions among themselves to draw more accurate judgments.

Armed with a clear sense of who has considerable leadership potential and what skills they need to develop, executives in these companies then spend time planning for that development. Sometimes that is done as part of a formal succession planning or high-potential development process; often it is more informal. In either case, the key ingredient appears to be an intelligent assessment of what feasible development opportunities fit each candidate's needs.

> Institutionalizing a leadership-centered culture is the ultimate act of leadership.

To encourage managers to participate in these activities, well-led businesses tend to recognize and reward people who successfully develop leaders. This is rarely done as part of a formal compensation or bonus formula, simply because it is so difficult to measure such achievements with precision. But it does become a factor in decisions about promotion, especially to the most senior levels, and that seems to make a big difference. When told that future promotions will depend to some degree on their ability to nurture leaders, even people who say that leadership cannot be developed somehow find ways to do it.

Such strategies help create a corporate culture where people value strong leadership and strive to create it. Just as we need more people to provide leadership in the complex organizations that dominate our world today, we also need more people to develop the cultures that will create that leadership. Institutionalizing a leadership-centered culture is the ultimate act of leadership.

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	MANAGEMENT	LEADERSHIP
WHAT IT'S ABOUT	COPING W/ COMPLEXITY BRINGS ORDER AND CONSIST EMPHASIS ON HIST. COMPENTENCE MAINTAIN PRESENT COURSE PROFIT MAKING	COPING W/CHANGE PRODUCES NEW ORDER CREATES NEW COMPETENCIES SETS NEW DIRECTION ENSURING FUTURE PROFITS
DERIVATION	DEDUCTIVE SERVES BOSSES	INDUCTIVE SERVES STAKEHOLDERS
MECHANISMS	PRODUCES "PLAN" LRP A PANACEA BUDGETING ORGANIZING AND STAFFING	PRODUCES VISION COMMUNICATION CONFLICT MANAGEMENT INSPIRING AND MOTIVATING
IND. SKILLS	PLANNING, ANALYSIZING CONTROLLING DEDUCTIVE PROBLEM SOLVING	CREDIBILITY (FN. TRACK RECORD, INTEGRITY, EXPERTISE) EMPOWERING INSPIRING AND MOTIVATING

Networking for Energy Efficiency

1. Objective:

   To facilitate the interchange of technical and policy information among practicing professionals to facilitate success in achieving energy efficiency and environmental enhancement.

2. Networking Methods:

   - Personal Interactions
     - Conferences: Technical (e.g. ASHRAE)
       Professional (e.g. DOE/EPA)
       Industrial trade shows
     - Faculty visiting/exchange programs
   - Electronic Communications
     - Electronic mail
     - Internet sites
   - Professional Group Newsletters

3. Specific Information for Network Dissemination:

   - Governmental policies considered or established
   - New technologies for incorporation into curricula
   - Energy/environment research opportunities

Energy Course and Outreach Program Design and Marketing

1. Options for the "Packaging" of New Energy Courses

   Full-Term Courses

   - Modify existing courses (e.g. design of internal combustion engines) to include new content (e.g. operation on alternate fuels, designs for minimizing tailpipe emissions).
   - Develop new courses (e.g. design of geothermal building heating systems)

   Condensed-Term Courses

   - Two-week "mini-term" course packaging (same total number of lecture hours)

2. Timing of Course Offerings

   - "Evening School" (attract area professionals)
   - During normal term breaks (e.g. two-week mini-term course)

3. Location of Course Offerings

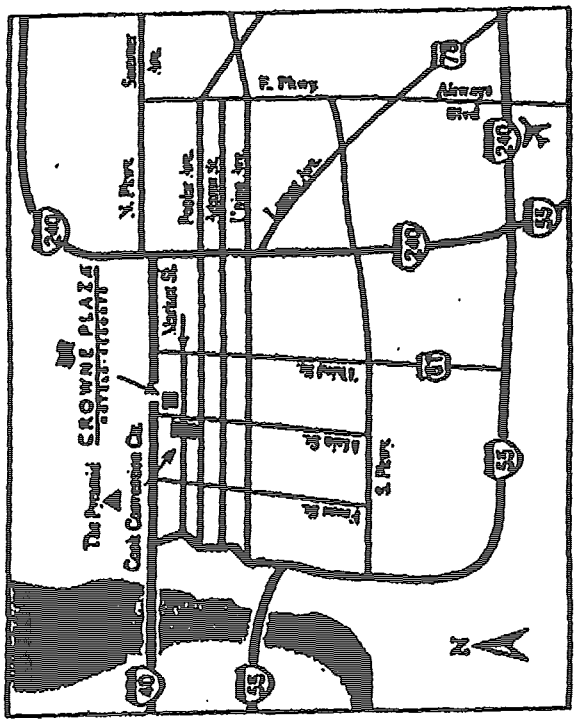
   - Normal on-campus sites
   - Regional satellite sites (e.g. University of Tennessee Knoxville/Oak Ridge locations)
   - Remote sites (via television transmission; network with other universities)

4. No-Credit Outreach Programs

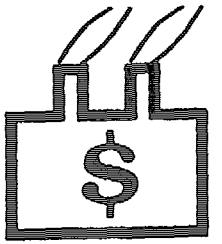
   - On-campus "short courses" (Certificate of participation)
   - Off-campus "short courses" (Certificate of participation)

Travel Directions

CROWNE PLAZA MEMPHIS
250 N. Main
Phone 901-527-7300



INDUSTRIAL ENERGY COST REDUCTION WORKSHOP



WHEN:

Tuesday, June 18, 1996

WHERE:

Crowne Plaza Memphis
Memphis, Tennessee

Sponsored by:

U.S. DEPARTMENT OF ENERGY
Office of Industrial Technologies

TENNESSEE DEPARTMENT OF ECONOMIC & COMMUNITY DEVELOPMENT
Energy Division

MEMPHIS LIGHT, GAS & WATER

THE UNIVERSITY OF TENNESSEE
INDUSTRIAL ASSESSMENT CENTER
Department of Mechanical and Aerospace Engineering and Engineering Science

Overview

This one day seminar, which will include presentations by industrial specialists, utility representatives and university faculty, will provide an overview of the most important energy management concerns for regional industrial facilities. It will be valuable for plant managers engineers and and maintenance supervisors who want to reduce annual O&M costs and organize effective energy management stratagies. The seminar is also appropriate for facility managers and corporate financial officers interested in:

- Gaining a better understanding of regional electric utilities rate schedules
- Reducing electricity demand charges
- Reducing lighting costs
- Reducing energy use in motor-driven systems
- Improving compressed air system efficiency
- Enhancing chiller system efficiency
- Strategies for controlling waste management costs
- Establishing and implementing effective in-plant energy conservation & waste minimization programs

Program

8:00 - 8:30	Registration - Refreshments provided
8:30 - 8:45	Introduction of sponsors and program overview
8:45 - 9:30	Understanding utility electric rate schedules
9:30 - 10:00	Strategies for reducing electricity demand charges
10:00 - 10:15	Break - Refreshments provided
10:15 - 10:45	Controlling facility lighting energy costs
10:45 - 11:15	Techniques for reducing energy use in motor-driven systems
11:15 - 12:00	Compressed air system efficiency improvements
12:00 - 1:00	Group Lunch; Crowne Plaza
1:00 - 1:45	Improvement of chiller system efficiency; refrigerant phase-out issues
1:45 - 2:30	Strategies for controlling waste management costs
2:30 - 2:50	Financing efficiency improvement measures
2:50 - 3:30	"Putting it all together": How to set-up effective programs in your facility
3:30 - 3:45	Discussion and wrap-up

Registration

Seating is limited so advance registration is requested. (Walk-ins will be admitted on a space-available basis.) Preregistration deadline is **Wednesday, June 12, 1996.**

The seminar is offered to area manufacturing facility personnel for $65 per participant and includes all workshop materials, lunch at the Crowne Plaza and all break refreshments.

To register, send a check payable to "The University of Tennessee" to:

University of Tennessee
Industrial Assessment Center
ATTN: Jonathan G. Overly,
Project Coordinator
310 Perkins Hall
Knoxville, TN 37996-2030

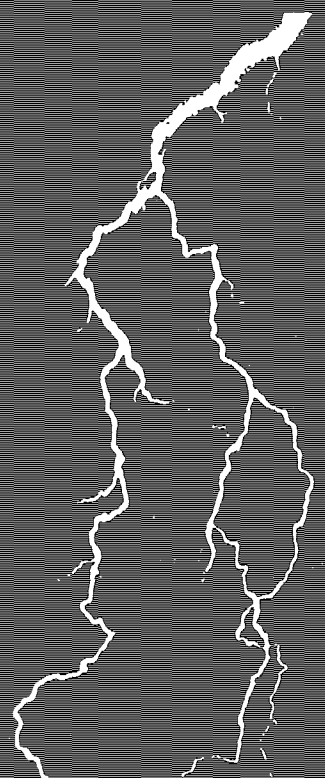
Include with your correspondence the following information:

- Company name
- Personnel name(s) attending
- Business address (including street, city and zip code)
- Business phone number

For workshop information, or to register by phone, please call Jonathan G. Overly at The University of Tennessee Industrial Assessment Center: (423) 974-5355.

Plant Engineering Series

North Carolina State University
Maintenance and Energy



FEBRUARY
Results Oriented Maintenance

MARCH
Preventive/Predictive Maintenance

Electricity for Non-Electricians

A Guide to The National Electric Code

Chilled Water and Air Distribution

Quality for Plant Engineers

APRIL
Basics of HVAC

Improving Maintenance Inventory Control

Air Conditioning and Refrigeration for Maintenance Personnel

The Maintenance Productivity Game

BIPE

Approved for recertification credits for the "Certified Plant Engineers" program by the American Institute of Plant Engineers

Professional Engineers NCSU is an approved source of Professional Development Hours

Sponsored by
INDUSTRIAL EXTENSION SERVICE
N.C. Manufacturing Extension Partnership
College of Engineering

Coordinated by
Continuing and Professional Education
Division of Continuing Studies
NORTH CAROLINA STATE UNIVERSITY

Energy Management Diploma Series

226

Program Objectives

The Energy Management Program opens its seventeenth year with new impetus from the Energy Policy Act of 1992. New and more stringent government reduction criteria are being placed on the Energy user. Ever increasing national and international competition accentuates the need for Energy Cost reductions. Education provides the most productive avenue for implementing an Energy cost reducing program. Our program is staffed by the most experienced of "hands on" Energy managers available, and has trained some of the most successful Energy Managers in the World.

EM-1 Managing Energy for Greater Profitability (2½ days)
February 3–5, 1997 Raleigh, NC

USA Energy Future
World Resources — Political and Economic Forces
Energy Accounting and Economics
How to Develop an Organizational Structure for Managing Energy
Procurement of Fuels
Workshop — Developing a Plan to Manage Energy
Strategic Planning — How to Develop a One Sheet Plan
Codes and Standards — Existing and Proposed

Course Fee for EM-1 and EM-2: $995

EM-2 How to Conduct and Maximize the Results of Your Energy Surveys (2½ days)
February 5–7, 1997 Raleigh, NC

How to Understand Electrical Costs and Rate Structures
Measuring Instruments for Energy Surveys
Demand Side Management - Definition and Opportunities
Computer Programs for Energy Survey Assistance
Survey Planning and Implementation
Case Study
Simulated Walk-through Audit
Low-Cost No-Cost Projects

Course Fee for EM-1 and EM-2: $995

EM-3 Improving Equipment Efficiencies (4½ days)
June 2–6, 1997 Raleigh, NC

Small HVAC Systems
Thermal Energy Storage
Electric Motors
Heat Recovery
Chillers and Cooling Towers
Cogeneration
Lighting
HVAC Controls
Boilers / Steam Systems
Energy Management Control Systems
Air Compressors

Course Fee: $995

EM-4 Industrial Energy Process and Building Analysis (4½ days)
October 13–17, 1997 Raleigh, NC

Building Envelope Analysis
Environmental Implications of EM
Large HVAC Systems
New Energy Technologies
Industrial Process Energy Analysis
Industrial / Commercial Plant Survey by Class
Energy Performance Analysis
Survey Presentations

Course Fee: $845

BEST AVAILABLE COPY

BEST AVAILABLE COPY

The College of Engineering
University of Wisconsin–Madison
Department of Engineering Professional Development
432 North Lake Street Madison, Wisconsin 53706

BEST AVAILABLE COPY

Nonprofit Organization
U.S. Postage
PAID
University of Wisconsin

This popular course will benefit

- Facility Engineers
- Utilities Engineers
- Utility Service Representatives

IMPORTANT!
UW SIDE

A limited enrollment offering...

Cogeneration Technology

March 3–7, 1997

in Las Vegas, Nevada

RICHARD JENDRUCKO
UNIV OF TENN
310 PERKINS HALL
KNOXVILLE TN 37996-0001

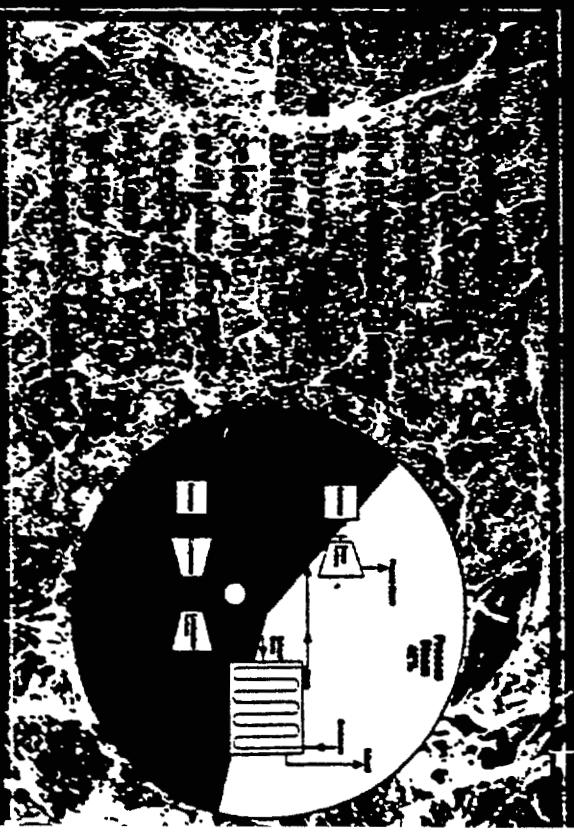
UW#W83

BEST AVAILABLE COPY

University of Wisconsin–Madison

Cogeneration Technology

March 3–7, 1997
in Las Vegas, Nevada



College of Engineering
Department of Engineering Professional Development

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Cogeneration Technology

March 3–7, 1997, in Las Vegas, Nevada

- Examine the utilization of current cogeneration technologies, matching end use electric and thermal loads with design concepts and equipment selection.
- Focus on the specific operating characteristics and economics of representative installations using gas turbines, internal combustion engines and steam turbines.
- Increase your overall understanding of the application of cogeneration technologies.
- Know how to conduct a feasibility analysis.

The Trend Toward Cogeneration

Since the implementation of PURPA in 1978, more than 29,300 MW of electric generation capacity from more than 2,500 facilities has come on line in the form of cogeneration, small power production, and independent power production. Installed capacity in this market segment is growing at the rate of 15 percent per year, representing more than $3 billion in annual business. Half (45,000 MW) of all the new capacity needs during the 1990s are expected to be provided by the private sector. Cogeneration site installations range from 30-KW packaged systems to multi-system installations of more than 1,000 MW.

Industrial plants, universities, hospitals, and commercial facilities with year-round steam, hot water, or cooling load or a combination of these are excellent candidates for the use of cogeneration technologies. Facilities with a 12-month electrical demand and large seasonal load variations, such as food processing plants or institutions with large air conditioning loads, can also benefit from this technology.

In this course, system cost guidelines along with a discounted cashflow economic computer model will help you to evaluate internal rate of return on investment and payback periods, which could be less than a year.

Computer Program

You will receive software that analyzes cogeneration options and heat recovery. We will provide hands-on training.

Calculators and Laptop Computers

Be sure to bring your calculator, which will be essential to effective and rapid calculations. If you have a laptop PC computer, we suggest you bring it to the course. This is not required, but may allow you to do more evening work related to this course.

Who Will Benefit

This course will help facility and consulting engineers to plan, select and evaluate the best cogeneration systems for their plants or clients. Utilities engineers will gain an understanding of various cogeneration applications to support customer cogeneration interests.

Course participants will learn to evaluate cogeneration against other energy system alternatives and conservation opportunities.

Certified Plant Engineer (CPE) Recertification Credit

To maintain status as a Certified Plant Engineer, a CPE must earn credits within each five-year period of certification. By attending this course, the CPE can earn one of the required eight credits. Simply submit a copy of the CEU certificate when applying for recertification. For more information on recertification or the CPE program in general, contact the American Institute of Plant Engineers at 513-489-2473.

Course Staff

Robert C. Erickson, President, Erickson Energy Applications Consulting, Guffey, Colorado

William A. Liegois, Process and Instrument Engineer, Stanley Consultants, Muscatine, Iowa

Charles E. Dorgan, Program Director, Department of Engineering Professional Development, University of Wisconsin–Madison

Walter P. Smith, Retired, Former Manager, Energy Technology and Conservation, BASF Corporation, Enka, North Carolina. Currently President, Energy Technology Services International, Candler, North Carolina

Course Outline

Monday, March 3

8:00 Registration—Coffee/Pastries
Tropicana Hotel
3801 Las Vegas Blvd. South
Las Vegas, Nevada

8:15 Course Introduction
Charles E. Dorgan

8:30 Cogeneration Overview
- Definitions/cycles
- Cogeneration efficiency
- PURPA
- Justification for cogeneration
- How cogeneration fits into the energy use pattern
- Load reduction and load shifting using absorbers, thermal storage, etc.
- Selecting and feasibility

Rules of Thumb for Phase I Concept Analysis
Walter P. Smith

10:30 Basic Thermodynamic Cycles
William A. Liegois

11:00 Single Line Utility Diagrams
- How to develop
- Power
- Steam
- Examples of diagrams
- Using to select cogeneration opportunities

Walter P. Smith

12:00 Lunch

1:00 Data Gathering and Load Profiles
- Plant energy use
- Collecting data
- Load duration curves
- Matching steam to electric loads
- Feasibility analysis
- Topping cycle
- Replace PRV
- Performance

Robert C. Erickson

2:45 Cogeneration: Steam Turbine Technology
- Steam turbine equipment
- Steam process diagrams
- Input and output

Course Outline continues inside

Course Outline continued...

- Process efficiency and cost
- Topping cycle
- Replace PRV with back pressure turbine
- Performance

Walter P. Smith

3:30 Introduction to Class Workshops

Group Problem

Staff

4:15 Workshop—One-Line Diagrams and Load Duration Curves

Staff

5:00 Social Hour (Cash Bar)

6:00 Adjournment

Tuesday, March 4

8:00 Coffee/Pastries

Workshop Review

Staff

9:00 Selecting Steam Turbines

- Back pressure
- Extraction
- Condensing
- Examples

William A. Liegois

10:30 Internal Combustion Engine—Generator

- Engine characteristics
- Fuels
- Operations and maintenance
- Heat recovery
- Heat exchangers
- Applications
- Package equipment
  - –advantages
  - –IC engines
  - –gas turbines
  - –absorption chillers
  - –cost
  - –system development

Robert C. Erickson

12:00 Lunch

1:00 Gas Turbine—Generators

- Gas turbine cycle
- Electric and heat balance
- Equipment characteristics
- Economics and installed costs
- Available equipment

William A. Liegois

3:00 Combined Cycle Gas Turbine

- Operating advantages
- Site needs
- Performance
- Selection

Walter P. Smith

4:00 Workshop—Cogeneration Options and Technology Selection

Staff

5:30 Adjournment

Wednesday, March 5

8:00 Coffee/Pastries

Workshop Review

Staff

9:00 Waste Heat Recovery

- Heat exchangers
- Steam turbine
- Diesel engines
- Gas turbine
- Waste heat boiler
- Supplemental duct burners

Robert C. Erickson

10:15 Emissions from Engines and Gas Turbines

William A. Liegois

11:00 Absorption Chillers and Ice Storage

Walter P. Smith/
William A. Liegois

12:00 Lunch

1:00 Water Treatment Review

Walter P. Smith

1:45 Electrical Interconnection

- Utility concerns
  - –distribution
  - –reliability
  - –safety
  - –system protection
- Multi-electrical connections
- Draft guidelines
- Owner concerns
  - –equipment protection
  - –cost
  - –safety and reliability
- Wheeling
- Case study

William A. Liegois/
Robert C. Erickson

3:00 Implementing Cogeneration, Avoiding Pitfalls

- Project management and strategy
- Selecting a consultant, technology, and hardware
- Operation and maintenance options
- Economics

Walter P. Smith

3:45 Workshop—Equipment Sizing and Data Collection for Model

Staff

5:30 Adjournment

Thursday, March 6

8:00 Coffee/Pastries

Workshop Review

Staff

9:00 Developing Budgetary Project Cost

- Major equipment
- Support equipment
- Environmental equipment
- Building work
- Fuel supply
- Electrical interconnections
- Utilities

William A. Liegois

10:15 Energy Audits and Process Optimization

Walter P. Smith

11:00 Computer Sizing of Gas Turbines and Heat Recover

Robert C. Erickson/
William A. Liegois

12:00 Lunch

1:00 Feasibility/Economic Methodology

- Economic modeling
- Sensitivity
- Spreadsheet models
- Data requirements
  - –utility rate
  - –load profile
  - –equipment/process use
  - –matching technologies
  - –equipment costs

Robert C. Erickson

2:30 Computer Modeling Examples

Robert C. Erickson

3:00 Evaluation of Cogeneration Designs

- Life cycle costs
  - –first cost
  - –power generation
  - –heat recovered
  - –maintenance
  - –operating labor
- Specifications

William A. Liegois

3:30 Workshop Problem Development with Computers

- Gas turbine
- IC engine
- Thermal storage/absorption
- Economics

Staff

4:00 Run Computer Models
Staff

5:30 Adjournment

Friday, March 7

8:00 Coffee/Pastries
Workshop Review
Staff

9:00 Operational Reliability
Robert C. Erickson

10:00 Case Studies
• Commercial, hospital, industrial
William A. Liegois, Robert C. Erickson and Invited Guests

12:00 Lunch

1:00 Optional General Discussion
Share your ideas, problems and solutions during this opportunity to visit with your instructors and fellow participants.

2:00 Final Adjournment

Schedule Note

Each day will begin at 8:00 with early coffee and pastries. There will be coffee/soft drink breaks at approximately 10:00 a.m. each morning and 2:30 p.m. each afternoon except Friday. Lunch will be served at noon each day.

Related Courses

To receive brochures on the following courses, please call 800-462-0876.

Process Piping ... #7069
April 14–18, 1997

HVAC for Industrial Facilities ...#7070
June 2–6, 1997

Psychrometric Processes and Load Calculations ...#7081
September 22–26, 1997

Energy Analysis for Industrial Refrigeration ...#7204
November 17–21, 1997

Four Easy Ways to Reach Us!

Phone:
800-462-0876 or
608-262-1299

Fax:
800-442-4214 or
608-265-3448

Mail to:
Engineering Registration
The Wisconsin Center
702 Langdon Street
Madison, Wisconsin 53706

Internet:
custserv@epd.engr.wisc.edu
http://epdwww.engr.wisc.edu/

Need to Know More?

Call toll free 800-462-0876 and ask for
Program Director:Charles E. Dorgan
Program Assistant: Mary Danielson

General Information

Fee Covers Notebook, program materials, break refreshments, lunches, and certificate.

Cancellation We prefer enrollment in advance. If you cannot attend, please notify us immediately. We will refund your fee, or you can have someone take your place.

Location and Accommodations The course will be held at the Tropicana Hotel, 3801 Las Vegas Blvd. South, Las Vegas, Nevada. We have reserved a block of sleeping rooms for course participants until February 2 at the rate of $70/person single or double. To reserve a room please call 702-739-2222 or toll free 800-634-4000 and indicate that you will be attending the University of Wisconsin–Madison course, *Cogeneration Technology*. Please advise us at time of enrollment if you are a person with a disability and desire special accommodations. Requests will be kept confidential.

Save on Air Travel Your enrollment confirmation will include details on discounted airfares.

UW–Madison provides equal opportunities in employment and programming, including Title IX requirements. This course is supported in part by funds administered through UW–Extension.

Enrollment Form

Important—please enter the 3-digit UW# Code from the mailing label.

UW# ☐ ☐ ☐

☐ Please enroll me in Course #7278
Cogeneration Technology
March 3–7, 1997 in Las Vegas, Nevada Fee: $1495 (5.0 CEU)

Please type or use ink; print information as you'd like it on your record.

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Phone (____) _____ Fax (____) _____

E-mail _____ Soc. Sec. Number *(Optional)* _____

☐ Bill my company ☐ P.O. or check enclosed *(Payable in U.S. funds to UW–Madison)*

☐ ☐ ☐

Cardholder's Name _____

Card No. _____ Expires _____

Please send information about future courses to:

Name _____

Title/Company _____

Address _____

City/State/Zip _____

Voluntary information collected to enhance UW programming

☐ Female ☐ Male

Birthdate: Month Day Year

Heritage:
☐ African American 1
☐ Asian/Pacific Islander 2
☐ American Indian/Alaskan Native 3
☐ Hispanic/Latino 4
☐ White/Other 5

Occupational Area:
☐ Engineering, Architecture & Surveying
☐ Other

Are you enrolled in this program primarily for career purposes?
☐ Yes ☐ No

Printed on recycled paper with vegetable based ink. Please recycle this in

UW# COURSE PERSONAL BILLING COLLEAGUE DEMOGRAPHICS

Networking for Energy Efficiency

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       Professional (e.g. DOE/EPA)
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     - Faculty visiting/exchange programs
   - Electronic Communications
     - Electronic mail
     - Internet sites
   - Professional Group Newsletters

3. Specific Information for Network Dissemination:

   - Governmental policies considered or established
   - New technologies for incorporation into curricula
   - Energy/environment research opportunities

PROGRAM EVALUATION
Content Modules

Please indicate how effective you believe the following sessions were in terms of their relevance in terms of content and pedagogy.

CONTENT SESSIONS

	This was mostly irrelevant	I will probably use something	I will use some content	I will use much content	I will use almost all of this content	This module had no effect on how I will teach in the future	I liked this session and how it was taught, but will have some difficulty adopting it	I liked this session and will try this approach
Friday, Feb. 13th Module V Introduction [Jendrucko]	☐	☐	☐	☐	☐	☐	☐	☐
Sat, Feb. 14th Module I Overview of linkages/Learning objectives and pedagogy [Jendrucko/Fryxell]	☐	☐	☐	☐	☐	☐	☐	☐
Sat, Feb. 14th Module II Commons Simulation [Fryxell]	☐	☐	☐	☐	☐	☐	☐	☐
Sat, Feb. 14th Module III Env. economics and regulation [Dean]	☐	☐	☐	☐	☐	☐	☐	☐
Sat, Feb. 14th Module IV Internet session [Kabele]	☐	☐	☐	☐	☐	☐	☐	☐
Sun, Feb. 15th Module I Electric power and mfg. plants [Jendrucko]	☐	☐	☐	☐	☐	☐	☐	☐
Sun, Feb. 15th Module II The "Green Lights" Case study [Dean]	☐	☐	☐	☐	☐	☐	☐	☐
Sun, Feb. 15th Module III The "Powerhouse" Simulation [Dean & Fryxell]	☐	☐	☐	☐	☐	☐	☐	☐
Sun, Feb. 15th Module IV Residential energy use and software [Kabele]	☐	☐	☐	☐	☐	☐	☐	☐
Mon, Feb. 16th Module I The Assessment Center Model [Jendrucko]	☐	☐	☐	☐	☐	☐	☐	☐
Mon, Feb. 16th Module II The "Carlesbad Highlands" Case [Fryxell]	☐	☐	☐	☐	☐	☐	☐	☐
Mon, Feb. 16th Module III Group decision making exercise [Fryxell]	☐	☐	☐	☐	☐	☐	☐	☐

Mon, Feb. 16th Module IV Energy & Env. resources on internet [Kabele]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐
Tues, Feb. 17th Module I Intro to TQEM and ISO 14000 [Fryxell]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐
Tues, Feb. 17th Module II International Electric Hardware Case [Dean]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐
Tues, Feb. 17th Module III The Fun Factory [Dean & Fryxell]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐
Tues, Feb. 17th Module IV Energy and env. resources on internet [Kabele]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐
Wed, Feb. 18th Module I Packaging of training [Jendrucko]	☐ ☐ ☐ ☐ ☐	☐ ☐ ☐

PROGRAM EVALUATION
General Questions

1) I am from:

Warsaw Tech ☐ A.G.H. ☐ Krakow Tech ☐ Silesian Tech ☐ Other ☐

	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
2) Overall, this program provided information that will be useful to the energy curriculum at my university	☐	☐	☐	☐	☐
3) The content of this program was appropriate and clear	☐	☐	☐	☐	☐
4) This program was well organized	☐	☐	☐	☐	☐

Appendix

Major U.S. Government-Sponsored Energy Technology and Environmental Management Programs

1. Current U.S. Department of Energy Initiatives:

   - Seven Vision Industries/Industrial Technologies Programs
   - Climate Wise (goal of reducing greenhouse gas emissions via energy conservation)
     - Industry contracts to identify and implement energy efficiency and pollution prevention actions. Results are reported periodically.
     - DOE provides access to technical and financial resources.
   - Motor Challenge Program (goal of reducing energy use in electric motor systems):
     - Industry contracts to incorporate energy efficiency as a necessary consideration in the design, purchase, and operation of electric motor systems. Also, industry agrees to employee education.
     - DOE agrees to:
       - Operate an information clearinghouse for access to motor system information.
       - Coordinate demonstrations of successful applications.
       - Provide recognition to Partners.
       - Sponsor training programs.
       - Seek to remove market barriers to the use of efficient motor systems.
     - Emphasis on:
       - High efficiency motors
       - Variable speed drives

- National Industrial Competitiveness Through Energy, Environment and Economics (NICE^3)

  - A cost-sharing grant program for the simultaneous reduction of industrial energy use, reduction of waste that is generated by industrial processes, and improvement of process economics.

- Energy-Related Inventions Program

  - Competitive grant program for funding the development of energy conserving or producing technologies.

2. Current U.S. Environmental Protection Agency Initiatives:

- Green Lights (goal of reducing power plant emissions via energy conservation resulting from lighting system upgrades).

  - Organizations including private industry, government and commercial businesses volunteer to become program partners and to install economically-attractive energy-efficient lighting systems.

- Energy Star (goal of reducing power plant emissions by encouraging the production and use of energy-efficient equipment).

  - Energy Star Office Equipment
  - Energy Star Computers
  - Energy Star Buildings
  - Energy Star Homes

- Design for the Environment (Office of Pollution Prevention and Toxics); Industry voluntary program to change business practices to provide incentives for pollution prevention; EPA and industries work with business and trade associations to evaluate risks, performance and costs of alternate chemicals, processes, and technologies; Specific programs:

  - Dry Cleaning Project
  - Printing Industry Project
  - Lifecycle Analysis of a Computer Workstation

Energy Efficiency Resources

1. U.S. Department of Energy

   - Energy Efficiency and Renewable Energy Clearinghouse
     P.O. Box 3048
     Merrifield, VA 22116
     (800) 273-2957

     - Fact sheets, publications
     - Technical responses to queries
     - Personal business assistance for entrepreneurs
     - Referrals to trade and professional associations, laboratories, state energy offices, and special interest groups

   - Energy Efficiency and Renewable Energy Network (EREN)

     - online library of resources offers news and archives about conservation techniques and developments of world energy technology.
       (Internet URL: <www.eren.doe.gov/>)

   - Special Programs:

     - Climate Wise (Reduction of greenhouse gases and resultant global warming)

       U.S. DOE
       Energy Efficiency and Renewable Energy
       1000 Independence Avenue, SW
       Washington, DC 20585
       Phone: (202) 586-1878
       Fax: (202) 586-711

     - Motor Challenge (Improvement in motor drive system efficiency)
       Phone: (800)862-2086
       Fax: (360)586-8303

     - NICE3 Program (Improvement of industrial competitiveness through energy efficiency, waste minimization and productivity improvement)

       U.S. Department of Energy
       Golden Colorado Field Office
       Phone: (303) 275-4755

- Energy-Related Inventions Program (Competitive grant program for funding the development of energy conserving or producing technologies.)

  Office of Technology Innovation
  National Institute of Standards and Technology
  Gaithersburg, MD 20899-0001
  Phone: (301) 975-5500
  Fax: (301) 975-3839
  E-mail: innovate@enh.nist.gov

- DOE-Sponsored Conferences

  Example:
  Second Industrial Energy Efficiency Symposium and Exposition, sponsored by the DOE Office of Industrial Technologies, to be held at the Hyatt Regency Crystal City Hotel, Arlington, Virginia, February 24-26, 1997.

2. Other Internet Resources

- International Energy Agency (IEA)

  - Fosters cooperation between participating countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology and research and development.
    (Internet URL: <www.zdsubs/zdim/>)

- Center for the Analysis and Dissemination of Demonstrated Energy Technologies-Energy Efficiency Center (CADDET) (Sittard, the Netherlands)

  - Objective is to broaden and improve the collection and exchange of information on energy-efficient technologies that have been demonstrated in the applications in industry, buildings, transport, utilities an;d agriculture.
    (Internet URL: <www.caddet-ee.org/>)

- International Institute for Energy Conservation (IIEC)

  - Accelerates the global adoption of energy-efficiency policies, technologies and practices in order to enable economically an ecologically sustainable development.
    (Internet URL: <www.crest.org/clients/iiec/>)

- World Energy Efficiency Association (WEEA)

  - Missions:
    1. To assist developing countries in accessing information on energy efficiency.
    2. To serve as a clearinghouse for information on energy efficiency programs, technologies and measures.
    3. To disseminate this information worldwide.
    4. To publicize international cooperation efforts in energy efficiency. (Internet URL: <www.weea.org/>)

- Solstice

  - A site for energy efficiency, renewable energy, and sustainable technology information.
    (Internet URL: <www.solstice.crest.org/>)

3. Professional Societies

- Association of Energy Engineers (8000 members in 52 countries)
  4025 Pleasantdale Road, Suite 420
  Atlanta, GA 30340-4264

  - Annual Meeting in Atlanta, fall each year
  - Sponsors several regional conferences with energy and environmental themes
  - Energy efficiency seminar series (throughout the U.S.)
  - Publications: Energy Engineering, Strategic Planning for Energy and the Environment
  - Energy manager certification program (by examination)

4. Not-For-Profit Organizations

- American Council for an Energy-Efficient Economy
  1001 Connecticut Avenue, NW, Suite 801
  Washington, DC 20036

  - Numerous recently-published books and research reports offered in the subject areas of energy and the environment, industrial and residential energy use efficiency, energy policy, utility issues, transportation systems and international topics.

- The Energy Efficiency Center
  Slezska
  120 56 Prague 2
  Phone: (42-2) 2425 2115, 2424 7552
  Fax: (42-2) 2424 7597
  E-mail: seven@ecn.cz

- Sponsors an annual international conference and exhibition dealing with a wide variety of Czech and international energy efficiency topics of current concern.

5. Book Publishers

Example:

- PennWell Publishing Company
  P.O. Box 21288
  Tulsa, OK 74121

  - Numerous recently-published books offered in the field of electric power generation.

Environmental Management Resources

1. U.S Environmental Protection Agency

   - Pollution Prevention Information Clearinghouse
     Environmental Protection Agency, PM 211-A
     401 M Street, SW
     Washington, DC 20460
     (202) 260-2602

     - Fact sheets, publications
     - Technical responses to inquiries

   - Environment

     - Provides a single repository for pollution prevention, compliance assurance, and enforcement information and databases; includes pollution prevention case studies, technologies, points of contact, environmental statutes, regulations and compliance and enforcement policies and guidelines.
       (Internet URL: <es.inel.gov/>)

   - EnviroFacts Database

     - Integrates environmental data extracted from five EPA program systems (Internet URL: <www.epa.gov/docs/enviro/html/ef_home.html/>)

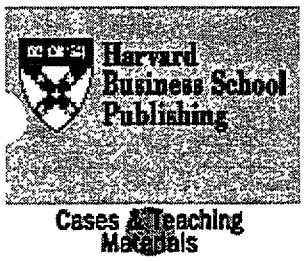
   - Special Programs:

     - Green Lights (Lighting energy conservation) and
     - Energy Star Programs (Energy efficient devices)
       U.S. EPA Atmospheric Pollution Prevention Division
       401 M. Street SW, (6202J)
       Washington, DC 20460
       Phone: (202) 233-9190
       fax: (202) 233-9569
       (Internet URL: Green Lights: <www.epa.gov/greenlights.html>; Energy Star: <www.epa.gov/energystar.html>)

2. U.S. Department of Energy

- Pollution Prevention Information Clearinghouse

  - Developed to enhance the exchange of pollution prevention information between Federal, state and local government agencies, as well as with industries, academic institutions and the general public.
    (Internet URL: <146.138.5.107/EPIC.EXE?EPIC>)



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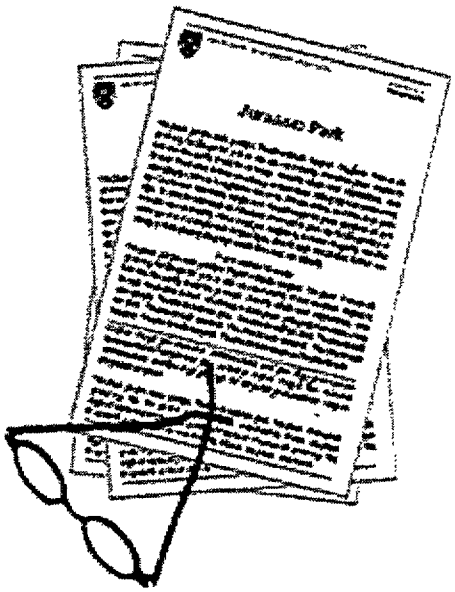

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1

The Tragedy of the Commons

GARRETT HARDIN

Garrett Hardin is Professor of Human Ecology Emeritus at the University of California at Santa Barbara.

At the end of a thoughtful article on the future of nuclear war, J. B. Wiesner and H. F. York concluded that "Both sides in the arms race are . . . confronted by the dilemma of steadily increasing military power and steadily decreasing national security. *It is our considered professional judgment that this dilemma has no technical solution.* If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation."[1]

I would like to focus your attention not on the subject of the article (national security in a nuclear world) but on the kind of conclusion they reached, namely, that there is no technical solution to the problem. An implicit and almost universal assumption of discussions published in professional and semipopular scientific journals is that the problem under discussion has a technical solution. A technical solution may be defined as one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality.

In our day (though not in earlier times) technical solutions are always welcome. Because of previous failures in prophecy, it takes courage to assert that a desired technical solution is not possible. Wiesner and York exhibited this courage; publishing in a science journal, they insisted that the solution to the problem was not to be found in the natural sciences.

"The Tragedy of the Commons," by Garret Hardin, from *Science*, v. 162 (1968), pp. 1243–48. Copyright 1968 by the AAAS. Reprinted by permission.

[1] J. B. Wiesner and H. F. York, *Scientific American* 211 (No. 4), 27 (1964).

They cautiously qualified their statement with the phrase, "It is our considered professional judgment. . . ." Whether they were right or not is not the concern of the present article. Rather, the concern here is with the important concept of a class of human problems which can be called "no technical solution problems," and more specifically, with the identification and discussion of one of these.

It is easy to show that the class is not a null class. Recall the game of tick-tack-toe. Consider the problem, "How can I win the game of tick-tack-toe?" It is well known that I cannot, if I assume (in keeping with the conventions of game theory) that my opponent understands the game perfectly. Put another way, there is no "technical solution" to the problem. I can win only by giving a radical meaning to the word "win." I can hit my opponent over the head; or I can falsify the records. Every way in which I "win" involves, in some sense, an abandonment of the game, as we intuitively understand it. (I can also, of course, openly abandon the game—refuse to play it. This is what most adults do.)

The class of "no technical solution problems" has members. My thesis is that the "population problem," as conventionally conceived, is a member of this class. How it is conventionally conceived needs some comment. It is fair to say that most people who anguish over the population problem are trying to find a way to avoid the evils of overpopulation without relinquishing any of the privileges they now enjoy. They think that farming the seas or developing new strains of wheat will solve the problem—technologically. I try to show here that the solution they seek cannot be found. The population problem cannot be solved in a technical way, any more than can the problem of winning the game of tick-tack-toe.

WHAT SHALL WE MAXIMIZE?

Population, as Malthus said, naturally tends to grow "geometrically," or, as we would now say, exponentially. In a finite world this means that the per-capita share of the world's goods must decrease. Is ours a finite world?

A fair defense can be put forward for the view that the world is infinite; or that we do not know that it is not. But, in terms of the practical problems that we must face in the next few generations with the foreseeable technology, it is clear that we will greatly increase human misery if we do not, during the immediate future, assume that the world available to the terrestrial human population is finite. "Space" is no escape.[2]

A finite world can support only a finite population; therefore, population growth must eventually equal zero. (The case of perpetual wide fluctuations above and below zero is a trivial variant that need not be

[2]G. Hardin, *Journal of Heredity* 50, 68 (1959), S. von Hoernor, *Science* 137, 18 (1962).

discussed.) When this condition is met, what will be the situation of mankind? Specifically, can Bentham's goal of "the greatest good for the greatest number" be realized?

No—for two reasons, each sufficient by itself. The first is a theoretical one. It is not mathematically possible to maximize for two (or more) variables at the same time. This was clearly stated by von Neumann and Morgenstern,[3] but the principle is implicit in the theory of partial differential equations, dating back at least to D'Alembert (1717–1783).

The second reason springs directly from biological facts. To live, any organism must have a source of energy (for example, food). This energy is utilized for two purposes: mere maintenance and work. For man, maintenance of life requires about 1600 kilocalories a day ("maintenance calories"). Anything that he does over and above merely staying alive will be defined as work, and is supported by "work calories" which he takes in. Work calories are used not only for what we call work in common speech; they are also required for all forms of enjoyment, from swimming and automobile racing to playing music and writing poetry. If our goal is to maximize population it is obvious what we must do: We must make the work calories per person approach as close to zero as possible. No gourmet meals, no vacations, no sports, no music, no literature, no art. . . . I think that everyone will grant, without argument or proof, that maximizing population does not maximize goods. Bentham's goal is impossible.

In reaching this conclusion I have made the usual assumption that it is the acquisition of energy that is the problem. The appearance of atomic energy has led some to question this assumption. However, given an infinite source of energy, population growth still produces an inescapable problem. The problem of the acquisition of energy is replaced by the problem of its dissipation, as J. H. Fremlin has so wittily shown.[4] The arithmetic signs in the analysis are, as it were, reversed; but Bentham's goal is unobtainable.

The optimum population is, then, less than the maximum. The difficulty of defining the optimum is enormous; so far as I know, no one has seriously tackled this problem. Reaching an acceptable and stable solution will surely require more than one generation of hard analytical work—and much persuasion.

We want the maximum good per person; but what is good? To one person it is wilderness, to another it is ski lodges for thousands. To one it is estuaries to nourish ducks for hunters to shoot; to another it is factory land. Comparing one good with another is, we usually say, impossible because goods are incommensurable. Incommensurables cannot be compared.

[3] J. von Neumann and O. Morgenstern, *Theory of Games and Economic Behavior* (Princeton University Press, Princeton, N.J., 1947), p. 11.

[4] J. H. Fremlin, *New Scientist*, No. 415 (1964), p. 285.

Theoretically this may be true; but in real life incommensurables *are* commensurable. Only a criterion of judgment and a system of weighting are needed. In nature the criterion is survival. Is it better for a species to be small and hideable, or large and powerful? Natural selection commensurates the incommensurables. The compromise achieved depends on a natural weighting of the values of the variables.

Man must imitate this process. There is no doubt that in fact he already does, but unconsciously. It is when the hidden decisions are made explicit that the arguments begin. The problem for the years ahead is to work out an acceptable theory of weighting. Synergistic effects, nonlinear variation, and difficulties in discounting the future make the intellectual problem difficult, but not (in principle) insoluble.

Has any cultural group solved this practical problem at the present time, even on an intuitive level? One simple fact proves that none has: there is no prosperous population in the world today that has, and has had for some time, a growth rate of zero. Any people that has intuitively identified its optimum point will soon reach it, after which its growth rate becomes and remains zero.

Of course, a positive growth rate might be taken as evidence that a population is below its optimum. However, by any reasonable standards, the most rapidly growing populations on earth today are (in general) the most miserable. This association (which need not be invariable) casts doubt on the optimistic assumption that the positive growth rate of a population is evidence that it has yet to reach its optimum.

We can make little progress in working toward optimum population size until we explicitly exorcise the spirit of Adam Smith in the field of practical demography. In economic affairs, *The Wealth of Nations* (1776) popularized the "invisible hand," the idea that an individual who "intends only his own gain," is, as it were, "led by an invisible hand to promote . . . the public interest."[5] Adam Smith did not assert that this was invariably true, and perhaps neither did any of his followers. But he contributed to a dominant tendency of thought that has ever since interfered with positive action based on rational analysis, namely, the tendency to assume that decisions reached individually will, in fact, be the best decisions for an entire society. If this assumption is correct it justifies the continuance of our present policy of *laissez faire* in reproduction. If it is correct we can assume that men will control their individual fecundity so as to produce the optimum population. If the assumption is not correct, we need to reexamine our individual freedoms to see which ones are defensible.

[5]A. Smith, *The Wealth of Nations* (Modern Library, New York, 1937), p. 423.

TRAGEDY OF FREEDOM IN A COMMONS

The rebuttal to the invisible hand in population control is to be found in a scenario first sketched in a little-known pamphlet in 1833 by a mathematical amateur named William Forster Lloyd (1794–1852).[6] We may well call it "the tragedy of the commons," using the word "tragedy" as the philosopher Whitehead used it: "The essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless working of things." He then goes on to say, "This inevitableness of destiny can only be illustrated in terms of human life by incidents which in fact involve unhappiness. For it is only by them that the futility of escape can be made evident in the drama."[7]

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility *to me* of adding one more animal to my herd?" This utility has one negative and one positive component.

1. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2. The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of −1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another. . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

[6] W. F. Lloyd, *Two Lectures on the Checks to Population* (Oxford University Press, Oxford, England, 1833).

[7] A. N. Whitehead, *Science and the Modern World* (Mentor, New York, 1948), p. 17.

Some would say that this is a platitude. Would that it were! In a sense, it was learned thousands of years ago, but natural selection favors the forces of psychological denial.[8] The individual benefits as an individual from his ability to deny the truth even though society as a whole, of which he is a part, suffers. Education can counteract the natural tendency to do the wrong thing, but the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed.

A simple incident that occurred a few years ago in Leominster, Massachusetts, shows how perishable the knowledge is. During the Christmas shopping season the parking meters downtown were covered with plastic bags that bore tags reading: "Do not open until after Christmas. Free parking courtesy of the mayor and city council." In other words, facing the prospect of an increased demand for already scarce space, the city fathers reinstituted the system of the commons. (Cynically, we suspect that they gained more votes than they lost by this retrogressive act.)

In an approximate way, the logic of the commons has been understood for a long time, perhaps since the discovery of agriculture or the invention of private property in real estate. But it is understood mostly only in special cases which are not sufficiently generalized. Even at this late date, cattlemen leasing national land on the Western ranges demonstrate no more than an ambivalent understanding, in constantly pressuring federal authorities to increase the head count to the point where overgrazing produces erosion and weed-dominance. Likewise, the oceans of the world continue to suffer from the survival of the philosophy of the commons. Maritime nations still respond automatically to the shibboleth of the "freedom of the seas." Professing to believe in the "inexhaustible resources of the oceans," they bring species after species of fish and whales closer to extinction.[9]

The National Parks present another instance of the working out of the tragedy of the commons. At present, they are open to all, without limit. The parks themselves are limited in extent—there is only one Yosemite Valley—whereas population seems to grow without limit. The values that visitors seek in the parks are steadily eroded. Plainly, we must soon cease to treat the parks as commons or they will be of no value to anyone.

What shall we do? We have several options. We might sell them off as private property. We might keep them as public property, but allocate the right to enter them. The allocation might be on the basis of wealth, by the use of an auction system. It might be on the basis of merit, as defined by some agreed-upon standards. It might be by lottery. Or it might be on a first-come, first-served basis, administered to long queues. These, I think, are all objectionable. But we must choose—or acquiesce in the destruction of the commons that we call our National Parks.

[8]G. Hardin, Ed., *Population, Evolution, and Birth Control* (Freeman, San Francisco, 1964), p. 56.
[9]S. McVay, *Scientific American* 216 (No. 8), 13 (1966).

POLLUTION

In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of the commons, but of putting something in—sewage, or chemical, radioactive, and heat wastes into water; noxious and dangerous fumes into the air; and distracting and unpleasant advertising signs into the line of sight. The calculations of utility are much the same as before. The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest," so long as we behave only as independent, rational, free-enterprisers.

The tragedy of the commons as a food basket is averted by private property, or something formally like it. But the air and waters surrounding us cannot readily be fenced, and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated. We have not progressed as far with the solution of this problem as we have with the first. Indeed, our particular concept of private property, which deters us from exhausting the positive resources of the earth, favors pollution. The owner of a factory on the bank of a stream—whose property extends to the middle of the stream—often has difficulty seeing why it is not his natural right to muddy the waters flowing past his door. The law, always behind the times, requires elaborate stitching and fitting to adapt it to this newly perceived aspect of the commons.

The pollution problem is a consequence of population. It did not much matter how a lonely American frontiersman disposed of his waste. "Flowing water purifies itself every ten miles," my grandfather used to say, and the myth was near enough to the truth when he was a boy, for there were not too many people. But as population became denser, the natural chemical and biological recycling processes became overloaded, calling for a redefinition of property rights.

HOW TO LEGISLATE TEMPERANCE?

Analysis of the pollution problem as a function of population density uncovers a not generally recognized principle of morality, namely: *the morality of an act is a function of the state of the system at the time it is performed.*[10] Using the commons as a cesspool does not harm the general public under frontier conditions, because there is no public; the same

[10] J. Fletcher, *Situation Ethics* (Westminster, Philadelphia, 1966).

behavior in a metropolis is unbearable. A hundred and fifty years ago a plainsman could kill an American bison, cut out only the tongue for his dinner, and discard the rest of the animal. He was not in any important sense being wasteful. Today, with only a few thousand bison left, we would be appalled at such behavior.

In passing, it is worth nothing that the morality of an act cannot be determined from a photograph. One does not know whether a man killing an elephant or setting fire to the grassland is harming others until one knows the total system in which his act appears. "One picture is worth a thousand words," said an ancient Chinese; but it may take ten thousand words to validate it. It is as tempting to ecologists as it is to reformers in general to try to persuade others by way of the photographic shortcut. But the essence of an argument cannot be photographed: it must be presented rationally—in words.

That morality is system-sensitive escaped the attention of most codifiers of ethics in the past. "Thou shalt not . . ." is the form of traditional ethical directives which make no allowance for particular circumstances. The laws of our society follow the pattern of ancient ethics, and therefore are poorly suited to governing a complex, crowded, changeable world. Our epicyclic solution is to augment statutory law with administrative law. Since it is practically impossible to spell out all the conditions under which it is safe to burn trash in the backyard or to run an automobile without smog control, by law we delegate the details to bureaus. The result is administrative law, which is rightly feared for an ancient reason—*Quis custodiet ipsos custodes*?—Who shall watch the watchers themselves? John Adams said that we must have a "government of laws and not men." Bureau administrators, trying to evaluate the morality of acts in the total system, are singularly liable to corruption, producing a government by men, not laws.

Prohibition is easy to legislate (though not necessarily to enforce); but how do we legislate temperance? Experience indicates that it can be accomplished best through the mediation of administrative law. We limit possibilities unnecessarily if we suppose that the sentiment of *Quis custodiet* denies us the use of administrative law. We should rather retain the phrase as a perpetual reminder of fearful dangers we cannot avoid. The great challenge facing us now is to invent the corrective feedbacks that are needed to keep custodians honest. We must find ways to legitimate the needed authority of both the custodians and the corrective feedbacks.

FREEDOM TO BREED IS INTOLERABLE

The tragedy of the commons is involved in population problems in another way. In a world governed solely by the principle of "dog eat dog"—if indeed there ever was such a world—how many children a family had would not be a matter of public concern. Parents who bred too exuberantly would leave fewer descendants, not more, because they would be unable to care adequately for their children. David Lack and others have found that such a negative feedback demonstrably controls the fecundity of birds.[11] But men are not birds, and have not acted like them for millenniums, at least.

If each human family were dependent only on its own resources; *if* the children of improvident parents starved to death; *if*, thus, overbreeding brought its own "punishment" to the germ line—*then* there would be no public interest in controlling the breeding of families. But our society is deeply committed to the welfare state,[12] and hence is confronted with another aspect of the tragedy of the commons.

In a welfare state, how shall we deal with the family, the religion, the race, or the class (or indeed any distinguishable and cohesive group) that adopts overbreeding as a policy to secure its own aggrandizement?[13] To couple the concept of freedom to breed with the belief that everyone born has an equal right to the commons is to lock the world into a tragic course of action.

Unfortunately this is just the course of action that is being pursued by the United Nations. In late 1967, some thirty nations agreed to the following: "The Universal Declaration of Human Rights describes the family as the natural and fundamental unit of society. It follows that any choice and decision with regard to the size of the family must irrevocably rest with the family itself, and cannot be made by anyone else."[14]

It is painful to have to deny categorically the validity of this right; denying it, one feels as uncomfortable as a resident of Salem, Massachusetts, who denied the reality of witches in the seventeenth century. At the present time, in liberal quarters, something like a taboo acts to inhibit criticism of the United Nations. There is a feeling that the United Nations is "our last and best hope," that we shouldn't find fault with it; we shouldn't play into the hands of the archconservatives. However, let us not forget what Robert Louis Stevenson said: "The truth that is suppressed by friends is the readiest weapon of the enemy." If we love the truth we must openly deny the validity of the Universal Declaration of Human Rights,

[11]D. Lack, *The Natural Regulation of Animal Numbers* (Clarendon Press, Oxford, England, 1954).
[12]H. Girvetz, *From Wealth to Welfare* (Stanford University Press, Stanford, Calif., 1950).
[13]G. Hardin, *Perspectives in Biology and Medicine* 6, 366 (1963).
[14]U Thant, *International Planned Parenthood News*, No. 168 (February 1968), p. 3.

even though it is promoted by the United Nations. We should also join with Kingsley Davis[15] in attempting to get Planned Parenthood–World Population to see the error of its ways in embracing the same tragic ideal.

CONSCIENCE IS SELF-ELIMINATING

It is a mistake to think that we can control the breeding of mankind in the long run by an appeal to conscience. Charles Galton Darwin made this point when he spoke on the centennial of the publication of his grandfather's great book. The argument is straightforward and Darwinian.

People vary. Confronted with appeals to limit breeding, some people will undoubtedly respond to the plea more than others. Those who have more children will produce a larger fraction of the next generation than those with more susceptible consciences. The differences will be accentuated, generation by generation.

In C. G. Darwin's words: "It may well be that it would take hundreds of genrations for the progenitive instinct to develop in this way, but if it should do so, nature would have taken her revenge, and the variety *Homo contracipiens* would become extinct and would be replaced by the variety *Homo progenitivus.*"[16]

The argument assumes that conscience or the desire for children (no matter which) is hereditary—but hereditary only in the most general formal sense. The result will be the same whether the attitude is transmitted through germ cells, or exosomatically, to use A. J. Lotka's term. (If one denies the latter possibility as well as the former, then what's the point of education?) The argument has here been stated in the context of the population problem, but it applies equally well to any instance in which society appeals to an individual exploiting a commons to restrain himself for the general good—by means of his conscience. To make such an appeal is to set up a selective system that works toward the elimination of conscience from the race.

PATHOGENIC EFFECTS OF CONSCIENCE

The long-term disadvantage of an appeal to conscience should be enough to condemn it: but it has serious short-term disadvantages as well. If we ask a man who is exploiting a commons to desist "in the name of con-

[15]K. Davis, *Science* 158, 730 (1967).

[16]S. Tax, Ed., *Evolution After Darwin* (University of Chicago Press, Chicago, 1960), vol. 2, p. 469.

science," what are we saying to him? What does he hear?—not only at the moment but also in the wee small hours of the night when, half asleep, he remembers not merely the words we used but also the nonverbal communication cues we gave him unawares? Sooner or later, consciously or subconsciously, he senses that he has received two communications, and that they are contradictory: 1. (intended communication) "If you don't do as we ask, we will openly condemn you for not acting like a responsible citizen"; 2. (the unintended communication) "If you *do* behave as we ask, we will secretly condemn you for a simpleton who can be shamed into standing aside while the rest of us exploit the commons."

Everyman then is caught in what Bateson has called a "double bind." Bateson and his co-workers have made a plausible case for viewing the double bind as an important causative factor in the genesis of schizophrenia.[17] The double bind may not always be so damaging, but it always endangers the mental health of anyone to whom it is applied. "A bad conscience," said Nietzsche, "is a kind of illness."

To conjure up a conscience in others is tempting to anyone who wishes to extend his control beyond the legal limits. Leaders at the highest level succumb to this temptation. Has any president during the past generation failed to call on labor unions to moderate voluntarily their demands for higher wages, or to steel companies to honor voluntary guidelines on prices? I can recall none. The rhetoric used on such occasions is designed to produce feelings of guilt in noncooperators.

For centuries it was assumed without proof that guilt was a valuable, perhaps even an indispensable, ingredient of the civilized life. Now, in this post-Freudian world, we doubt it.

Paul Goodman speaks from the modern point of view when he says: "No good has ever come from feeling guilty, neither intelligence, policy, nor compassion. The guilty do not pay attention to the object but only to themselves, and not even to their own interests, which might make sense, but to their anxieties."[18]

One does not have to be a professional psychiatrist to see the consequences of anxiety. We in the Western world are just emerging from a dreadful two centuries-long Dark Ages of Eros that was sustained partly by prohibition laws, but perhaps more effectively by the anxiety-generating mechanisms of education. Alex Comfort has told the story well in *The Anxiety Makers;*[19] it is not a pretty one.

Since proof is difficult, we may even concede that the results of anxiety may sometimes, from certain points of view, be desirable. The larger question we should ask is whether, as a matter of policy, we should ever encourage the use of a technique the tendency (if not the intention) of

[17]G. Bateson, D. D. Jackson, J. Haley, J. Weakland, *Behavioral Science* 1, 251 (1956).
[18]P. Goodman, *New York Review of Books* 10 (8), 22 (23 May 1968).
[19]A. Comfort, *The Anxiety Makers* (Nelson, London, 1967).

which is psychologically pathogenic. We hear much talk these days of responsible parenthood; the coupled words are incorporated into the titles of some organizations devoted to birth control. Some people have proposed massive propaganda campaigns to instill responsibility into the nation's (or the world's) breeders. But what is the meaning of the word conscience? When we use the word responsibility in the absence of substantial sanctions, are we not trying to browbeat a free man in a commons into acting against his own interest? Responsibility is a verbal counterfeit for a substantial quid pro quo. It is an attempt to get something for nothing.

If the word responsibility is to be used at all, I suggest that it be in the sense Charles Frankel uses it.[20] "Responsibility," says this philosopher, "is the product of definite social arrangements." Notice that Frankel calls for social arrangements—not propaganda.

MUTUAL COERCION MUTUALLY AGREED UPON

The social arrangements that produce responsibility are arrangements that create coercion, of some sort. Consider bank robbing. The man who takes money from a bank acts as if the bank were a commons. How do we prevent such action? Certainly not by trying to control his behavior solely by a verbal appeal to his sense of responsibility. Rather than rely on propaganda we follow Frankel's lead and insist that a bank is not a commons: we seek the definite social arrangements that will keep it from becoming a commons. That we thereby infringe on the freedom of would-be robbers we neither deny nor regret.

The morality of bank robbing is particularly easy to understand because we accept complete prohibition of this activity. We are willing to say, "Thou shalt not rob banks," without providing for exceptions. But temperance also can be created by coercion. Taxing is a good coercive device. To keep downtown shoppers temperate in their use of parking space we introduce parking meters for short periods, and traffic fines for longer ones. We need not actually forbid a citizen to park as long as he wants to; we need merely make it increasingly expensive for him to do so. Not prohibition, but carefully biased options are what we offer him. A Madison Avenue man might call this persuasion; I prefer the greater candor of the word coercion.

Coercion is a dirty word to most liberals now, but it need not forever be so. As with the four-letter words, its dirtiness can be cleansed away by exposure to the light, by saying it over and over without apology or

[20]C. Frankel, *The Case for Modern Man* (Harper & Row, New York, 1955), p. 203.

embarrassment. To many, the word coercion implies arbitrary decisions of distant and irresponsible bureaucrats; but this is not a necessary part of its meaning. The only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected.

To say that we mutually agree to coercion is not to say that we are required to enjoy it, or even to pretend we enjoy it. Who enjoys taxes? We all grumble about them. But we accept compulsory taxes because we recognize that voluntary taxes would favor the conscienceless. We institute and (grumblingly) support taxes and other coercive devices to escape the horror of the commons.

An alternative to the commons need not be perfectly just to be preferable. With real estate and other material goods, the alternative we have chosen is the institution of private property coupled with legal inheritance. Is this system perfectly just? As a genetically trained biologist I deny that it is. It seems to me that, if there are to be differences in individual inheritance, legal possession should be perfectly correlated with biological inheritance—that those who are biologically more fit to be the custodians of property and power should legally inherit more. But genetic recombination continually makes a mockery of the doctrine of "like father, like son" implicit in our laws of legal inheritance. An idiot can inherit millions, and a trust fund can keep his estate intact. We must admit that our legal system of private property plus inheritance is unjust—but we put up with it because we are not convinced, at the moment, that anyone has invented a better system. The alternative of the commons is too horrifying to contemplate. Injustice is preferable to total ruin.

It is one of the peculiarities of the warfare between reform and the status quo that it is thoughtlessly governed by a double standard. Whenever a reform measure is proposed it is often defeated when its opponents triumphantly discover a flaw in it. As Kingsley Davis has pointed out,[21] worshipers of the status quo sometimes imply that no reform is possible without unanimous agreement, an implication contrary to historical fact. As nearly as I can make out, automatic rejection of proposed reforms is based on one of two unconscious assumptions: (1) that the status quo is perfect; or (2) that the choice we face is between reform and no action; if the proposed reform is imperfect, we presumably should take no action at all, while we wait for a perfect proposal.

But we can never do nothing. That which we have done for thousands of years is also action. It also produces evils. Once we are aware that the status quo is action, we can then compare its discoverable advantages and disadvantages with the predicted advantages and disadvantages of the proposed reform, discounting as best we can for our lack of experience.

[21]See J. D. Roslansky, *Genetics and the Future of Man* (Appleton-Century-Crofts, New York, 1966), p. 177.

On the basis of such a comparison, we can make a rational decision which will not involve the unworkable assumption that only perfect systems are tolerable.

RECOGNITION OF NECESSITY

Perhaps the simplest summary of this analysis of man's population problems is this: the commons, if justifiable at all, is justifiable only under conditions of low-population density. As the human population has increased, the commons has had to be abandoned in one aspect after another.

First we abandoned the commons in food gathering, enclosing farmland and restricting pastures and hunting and fishing areas. These restrictions are still not complete throughout the world.

Somewhat later we saw that the commons as a place for waste disposal would also have to be abandoned. Restrictions on the disposal of domestic sewage are widely accepted in the Western world; we are still struggling to close the commons to pollution by automobiles, factories, insecticide sprayers, fertilizing operations, and atomic energy installations.

In a still more embryonic state is our recognition of the evils of the commons in matters of pleasure. There is almost no restriction on the propagation of sound waves in the public medium. The shopping public is assaulted with mindless music, without its consent. Our government has paid out billions of dollars to create a supersonic transport which would disturb 50,000 people for every one person whisked from coast to coast 3 hours faster. Advertisers muddy the airwaves of radio and television and pollute the view of travelers. We are a long way from outlawing the commons in matters of pleasure. Is this because our Puritan inheritance makes us view pleasure as something of a sin, and pain (that is, the pollution of advertising) as the sign of virtue?

Every new enclosure of the commons involves the infringement of somebody's personal liberty. Infringements made in the distant past are accepted because no contemporary complains of a loss. It is the newly proposed infringements that we vigorously oppose; cries of "rights" and "freedom" fill the air. But what does "freedom" mean? When men mutually agreed to pass laws against robbing, mankind became more free, not less so. Individuals locked into the logic of the commons are free only to bring on universal ruin; once they see the necessity of mutual coercion, they become free to pursue other goals. I believe it was Hegel who said, "Freedom is the recognition of necessity."

The most important aspect of necessity that we must now recognize is the necessity of abandoning the commons in breeding. No technical solution can rescue us from the misery of overpopulation. Freedom to breed

will bring ruin to all. At the moment, to avoid hard decisions many of us are tempted to propagandize for conscience and responsible parenthood. The temptation must be resisted, because an appeal to independently acting consciences selects for the disappearance of all conscience in the long run, and an increase in anxiety in the short.

The only way we can preserve and nurture other and more precious freedoms is by relinquishing the freedom to breed, and that very soon. "Freedom is the recognition of necessity"—and it is the role of education to reveal to all the necessity of abandoning the freedom to breed. Only so can we put an end to this aspect of the tragedy of the commons.

Industrial Engineering
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NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

The Tragedy of the Commons and the Decision-Maker

Prepared by Leith Harmon, NPPC Research Assistant. The NPPC would like to thank Don Fuller, Associate Professor of Marketing at the University of Central Florida for his emendations to this case.

Background and Problem Statement

In 1968, Garret Hardin wrote an article in *Science*[1] titled "The Tragedy of the Commons." The article had a significant impact, and the issues it presented were much debated in the fields of ecology, law, philosophy, and psychology. An excerpt of the article that defines the problem follows:

> The tragedy of the commons develops this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.
>
> As a rational being, each herdsman seeks to maximize his gain, Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component.
>
> 1. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.
>
> 2. The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1.
>
> Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another, and another . . . But his conclusion is reached by each and every rational herdsman sharing the commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

The article continues with the moral, legal, and philosophical implications of the dilemma. While these discussions are beyond the scope of this exercise, you are encouraged to read the entire article.

Questions

You and four other farmers lease land from the government to graze your cattle. The land can support 100 healthy cows, where a healthy cow weighs 500 lbs. (For the sake of simplicity, assume that a cow cannot exceed 500 lbs., and that the entire 500 lbs. is meat available for market). For every cow (above 100) added to the field, each suffers a 10-lb. reduction in weight. Further, assume a cow cannot survive (or is not marketable) below 300 lbs. The government believes in a self-policing policy — you and your fellow farmers must manage your herds on your own. Then answer the questions on the next page.

[1] Hardin, Garrett. "The Tragedy of the Commons." *Science* (December 13, 1968): 1243–1248.

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1. Graph the weight of each cow as a function of the number of cows in the field.

2. How many cows will cause the commons to collapse (i.e., at what point does the field fail to support any cattle)?

3. Each farmer (you and the four others) has 20 head of cattle. Develop a spreadsheet that shows the "payoff" or "profit" (your payoff = the number of pounds of cattle) that results from your decision to add or not add one cow vs. every one of the other farmers' decision to add or not add one cow each (the payoff should be in total pounds for each farmer's herd). As an example, the payoff for no one adding more cattle would appear as follows:

You add:	Others add:	Your payoff:	Others' payoff:
0	0	10,000	10,000

Repeat for two and three cows.

4. As a profit-maximizing farmer, do you add cattle? What do the other profit-maximizing farmers do?

5. Now, assume that the other farmers come to you with a plan to share the payoff or profits of a common herd (assuming all five farmers). Show, on a spreadsheet, the results of your decision to add or not add one cow vs. every one of the other farmers' decisions to add or not add one cow.

6. What stands in the way of implementing the plan in Question 5?

7. What other agricultural and industrial systems might be prone to the "Tragedy of the Commons" problem?

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For the Instructor: Teaching Note on "The Tragedy of the Commons and the Decision-Maker"

Purpose

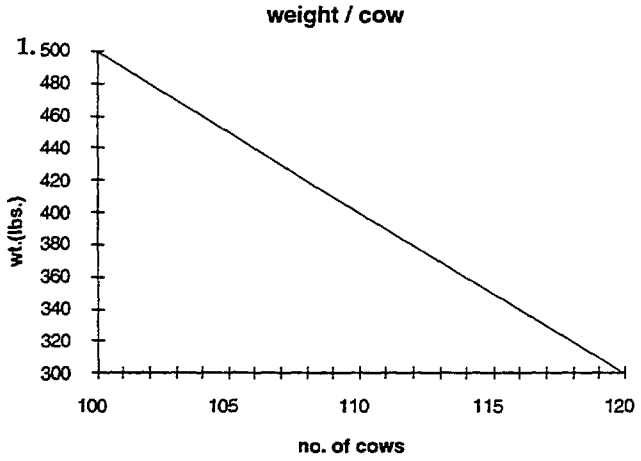
Increasingly, decision analysis techniques are being applied to decisions outside the traditional engineering and business spheres. This exercise is designed to show students that decision analysis is an effective tool for complex environmental issues.

The accompanying article, "The Tragedy of the Commons and the Decision Maker," investigates the failure of the rational decision model under certain resource allocation conditions. Students step through a decision matrix quantitatively showing "the tragedy of the commons." Further questions investigate social systems that can be employed to reduce the impact of the "tragedy."

This material was designed for inclusion in an introductory decision analysis course in industrial engineering; it is also appropriate for MBA students. Students should be familiar with the basic concepts of expected value and decision matrices.

Answers

1.



2. The Commons collapses with 120 cows.

3. Using theses formulae, where y=you and x=others:
your payoff = (20 + y)(500 - 10(y + 4x)),
and if all others add cows, and you don't,
their payoff = (20 + x)(500 - 10(y + 4x))

You add:	Others each add:	Your payoff:	Others' payoff:
0	0	10,000	10,000
1	0	10,290	9,800
0	1	9,200	9,660
1	1	9,450	9,450
0	0	10,000	10,000
2	0	10,560	9,600
0	2	8,400	9,240
2	2	8,800	8,800
0	0	10,000	10,000
3	0	10,810	9,400
0	3	7,600	8,740
3	3	8,050	8,050

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4. As a profit maximizer, you and the other farmers will add cows until the commons collapses.

5. Using the formula
individual profit = $((100 + y + 4x)(500 - 10\,(y + 4x)))/5$
where y=you and x=others, the following results:

You add:	Others each add:	Your payoff:	Others' payoff:
0	0	10,000	10,000
1	0	9,898	9,898
0	1	9,568	9,568
1	1	9,450	9,450

6. To succeed, the common herd plan must be accepted by all farmers. If one farmer breaks the agreement, s/he makes profits at the other farmers' expense (as is evident in Question 3). Further, this system hints of socialism—an idea that has its own problems. Generally, the problem must become bad enough to encourage participants to adopt the mutual system.

7. Some examples include:

- groundwater (industrial use vs. drinking water)
- breathable air
- timber
- fisheries

The matrix at the end of this compendium's Resource List indicates eight books and articles on decision analysis and industrial engineering.

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Management 581
Issues in Environmental Management
Fall,, 1996, Section 55553
University of Tennessee at Knoxville
Tuesday 6:30-9:10; G51

Course Coordinator:	Jerry Fryxell	ph. 974-1664
Co-Instructors:	Chuck Bamford	ph. 974-3161
	Iain Clelland	ph. 974-1672
	Pete Counce (Eng.)	ph. 974-5318
	Tom Dean	ph. 974-1673
	Tom Douglas	ph. 974-3161

Class Time and Place:

Tuesday, 6:30-9:10 P.M.
Glocker Business Building, Rm 51

Required Materials:

Tibor, T. & Feldman, I. 1996. ISO 14000: A Guide to the New Environmental Management Standards. Chicago: Irwin. (Hereafter referred to as "TIBOR")

Readings packet to be available at: Graphic Creations, 1809 Lake Ave. 5-6221 (in two sets ... an addendum will be printed for last third of class).

Course Content and Pedagogy

The natural environment has become a strategic issue for increasing numbers of firms and industries. As a result, organizations that survive and prosper in the future must learn to blend economic as well as ecological criteria into their decision-making processes. The overall aim of this course is to better prepare future managers to accomplish this. Specifically, the objectives of this course are to:

1) Make students more aware of the pervasiveness and complexity of environmental issues that confront modern businesses and to clarify their personal values regarding these issues.
2) Provide students with several tools that are currently being used to integrate natural resource and pollution concerns into business decisions. Foremost among the tools we will examine are the ISO 14000 standards. ISO 14000 are environmental management standards for corporations which are expected to have a significant impact on both foreign

and domestic firms.

3) Have students explore the implications of taking a proactive approach to environmental issues in business and to explore the strategic implications thereof.

Pedagogically, we feel strongly that the learning occurs best through "learning by doing" and by active interaction between the students and the instructors. We also view ourselves more as facilitators of your learning, rather than as the experts that lecture on the true nature of the world and these relationships. Accordingly, we will utilize topical discussions with guest speakers, experiential exercises, simulations, videos, and cases to facilitate the learning process. It is important that the students realize that this philosophy places greater responsibility on them to be prepared for class and to actively participate in the class exercises and discussions. We expect that the class will learn from each other's education and experience, and encourage the students to express their knowledge in class discussions.

Course Principles

1. Hard work: Hard work and determination represent the foundation to personal progress and success.

2) Positive Attitude and Humor: A lighter, positive side exists to most daily activities and events; let's have some fun.

3) Academic Integrity: Students will uphold the university honor code in all matters pertaining to this course. All work submitted must be original and all non-original concepts integrated into student papers must be referenced as such. Cheating on examinations or other assignments will result, at a minimum, in an F grade on that assignment.

4) Respect for Others: We recognize the desire of others to be heard without interruption. When a person is speaking, the remainder of the class should remain attentive. During any controversial discussions that may ensue, we will attempt to use appropriate timing when presenting our thoughts (allow other to compete their argument before speaking on your own opinions.)

5) Professionalism: With each other, with the guest speakers, and with the companies involved in the field project.

Course Requirements

Class Attendance and Participation (25%)

Class preparation and participation are a fundamental aspect of this course and crucial to your performance in the class. The emphasis here cannot be understated. Since much of your learning will occur as a result of class discussion, getting your value as a paying student and the success of the overall class are dependent upon your being prepared and demonstrating it in class (an interesting variant on the basic "commons problem" which will be discussed further in this introductory class session). In this regard, it is important to point out that quality of contribution is more important than sheer quantity. (Indeed, noncontributory could actually take away from our learning goals.) It is also obvious that you cannot participate in the class when you are not

present. Thus, you are expected to attend all of the class periods.

Participation will be evaluated by both peers and the course coordinator at the conclusion of each class period. To increase the validity of these assessments, peer evaluators will be used. This job will be rotated each class session, so that all class members will be involved over the term.

State of the Art Environmental Practice Research Project (25%)

You likely have either business or technical training in a particular business function or activity. At present, most firms are just beginning to extended environmental policies, programs, or methods to business operations such as accounting, purchasing, finance, and marketing. The purpose of this individual research project is to give you and opportunity to study (i.e., investigate (identify, categorize, analyze, and make recommendations) about the state of environmental practice in your particular area of interest. Alternatively, this paper could have an industry focus.

Consequently, this project will involve library research, contact with the relevant professional or industry associations, and/or interviews with knowledgeable professionals. In some cases (i.e., finance) it may be difficult to identify environmentally-based methods currently in use. If this occurs, investigate what practices are bing proposed for adoption in the future. What are the advantages and disadvantages of adopting this method? What are the key factors associated with successful implementation?

You will need to submit a one page proposal for the topic of the paper by Sept. 17. The end product of this effort will be a 10-12 page (text) double-spaced, typed report. If you have exhibits or figures, they may be added as appendices. The paper is due in class on October 15, so you will need to start on it early. Please submit two copies; non-reusable covers are unnecessary.

Group Field Project (40%)

This project will provide an opportunity to apply what you have learned from your individual project and the course to a local organization. On September 26, we will form cross-functional teams (3 or 4 on a team) based on your functional specialty and/or your interest in an available project. Your team will be partnered with a local company in a consulting capacity.

Ideally, your team's task is to evaluate the company's operations against state-of-environmental practices you previously identified in your individual papers and then present your recommendations to company management about what types of environmental practices could be implemented and how best to implement them. Of course, one useful benchmark for this evaluation could be the ISO 14000 standards (which is the main reason they have been front-loaded in the schedule of assignments); however, the exact scope of the project can be adjusted according to the needs of the participating firm and the capabilities of the team.

On October 15 you will be required to submit a one-page report discussing your team's first visit with the client and outlining the scope and depth of the project. On December 3 your report will be due. Moreover, you will be required to present your evaluation, recommendations, and management's reactions to the class. The presentation will contribute one-third to the overall

grade for this assignment. The paper should be at least 12-15 (text) paged double-spaced report. Please submit two copies. Finally, the course coordinator will provide peer evaluation forms and these may be used to adjust your grade on group assignments.

Reading Evaluations

From time to time you will be asked to write a short response to a question about that evenings readings. The purpose of this is to measure the extent to which you are prepared for class. This will be unannounced and may not be made up. Consequently, the lowest score on these "quizzes" will be dropped.

CLASS SCHEDULE AND ASSIGNMENTS

#1 8/27 Course Introduction

Instructor: Jerry Fryxell

Objective: Introduce students to the course, stimulate thinking about the problems associated with the exploitation of common resources and the social dynamics involved, various approaches to solving the problems, and individual obligations.

Special activity: Commons simulation

#2 9/3 Environmental Economics and Regulation

Instructor: Tom Dean

Guest Speaker: David Feldman, EERC

Objective: Introduce students to the fundamental concepts of environmental economics. This will help you to understand the economic causes of environmental degradation, provide a crucial perspective for analyzing environmental issues, and a context in which to review of national environmental legislation and the environmental regulatory structure.

Preparatory Readings:

Schmidheiny, S. 1992. Changing course: A global business perspective on development and the environment, Boston: MIT Press. Chapter 1 & 2 (pp. 1-33)

Webber, D. J. 1990. United States (Chp.16) in International public policy sourcebook (V2): Education and environment., Frederic Bolotin (ed.), Greewood Press: 335-352.

#3 9/10 Environmental Strategy and Environmental Management Systems (ISO 14000)

Instructors: Tom Dean & Jerry Fryxell

Objective: To understand the role environmental management may play in business and corporate strategy. To acquaint students with the ISO14000

standards, their development, and the rationale for the process.

Preparatory Readings:

MEB Case Study: Measuring Environmental Performance and the ISO/CD 14001 Environmental Management Systems--Specs.

-- a copy of the draft international standard (DIS) prior to July, 1996

TIBOR: Chps 1-3.

#4 9/17 EMS (ISO 14000) -- Gap analysis and Environmental Policies, Objectives and Targets

Instructors: Tom Dean & Jerry Fryxell

Objective: To begin applying the ISO14000 standards through a "gap analysis," the development of an environmental policy, and setting objectives/targets.

Preparatory Readings:

TIBOR: Chp. 4

#5 9/24 Environmental Auditing & Accounting

Instructors: Iain Clelland

Guest Speaker: Harold Roth (Acct.)

Objective: Good monitoring and reporting systems are critical to a firm pursuing excellent environmental performance. Two of the most common tools that firms are establishing (or expanding on) are environmental auditing and accounting methods and policies. This class will review how these methods operate and their relationship with reporting requirements.

Preparatory Readings:

TIBOR: Chp. 6

Jones, L. & Baldwin, J. 1994. Evaluating corporate environmental performance. Corporate Environmental Policy and Government Regulation: 45-61.

DIS ISO/CD 14011/1.2 "Guidelines for Environmental Auditing." [possible addition from H. Roth unavailable at time of packet]

#6 10/1 Global Environmental Issues and Sustainable Development

Instructor: Chuck Bamford

Objective: To examine the complexities, opportunities, and potential pitfalls of environmental issues that impact international business efforts. To develop a basic understanding of issues involved in sustainable development projects/programs.

Preparatory Readings:

TIBOR: Chp. 7
Speth, J. G. 1986. A new environmental agenda. Forum for Applied Research and Public Policy: 22-35.
Ruckleshaus, W.D. 1989. Toward a sustainable world. Scientific American: 166-175.
Repetto. R. 1987. Managing natural resources for sustainability. In T.J. Davis & I.A. Schirmer (eds.) Sustainability issues in agricultural development: 166-175.

Special activity: "Double Death Dilemma"

#7 10/8 Stakeholder Issues in Environmental Management

Instructor: Jerry Fryxell

Objective: To understand the legitimacy of stakeholder viewpoints on environmental issues and to learn a more systematic process for incorporating stakeholder views into a company's environmental strategy.

Preparatory Reading:

Chp. 3 in Wood, D. J. 1990. Business and Society. Glenview, Ill.: Scott, Foresman & Co.: 76-106.

Special activity: "Rainforest Negotiation Exercise"

Advance Assignment for 10/15: A one page write-up of green product, service, or advertisement

Advance Assignment for 10/22: Research on Eco-labelling

#8 10/15 Env. Marketing

Instructor: Tom Dean

Objective: This class is designed to introduce students to the issues surrounding the concept of green marketing and the nature of green consumers. Case analysis will be used to show how one firm used environmental considerations to its advantage in marketing products. We will also address the hazards and problems associated with green marketing and recent trends in the area.

Preparatory Readings:

Case study: Loblaw Companies Limited
Ottman, J. 1993. Green marketing. NTC Business Books, Chps. 1&2.
Rice, F. 1993. Who scores best on the environment? Fortune: 114-122.

Special Activity: Green consumer quiz

Preparatory Assignments:

A one page write-up of green product, service, or advertisement.

Advanced Assignments for 10/22 and 10/29:

• Obtain and complete Environmental Attitudes Survey (to be turned in 10/22 for tabulation and discussion on 10/29)

• Assess another class you are taking this semester with the "Sustainable Values" questionnaire. Bring result to class on 10/29.

#9 10/22 Life Cycle Analysis (LCA) and Env. Labelling

Instructor: Iain Clelland

Guest Speaker: Representative from UT Center for Clean Products & Technology)

Objective: To understand how the evolving tool of LCA is applied to help companies understand the environmental impacts associated with their products, processes, and activities. To understand how seal-of-approval, single-attribute certification, and product environmental information programs operate as forms of third-party environmental labelling.

Preparatory Readings:

TIBOR: Chps. 8-10

Preparatory Assignment:

a) Research on eco-labelled product using Internet. seal-of-approval organizations, and comparative shopping. End product is brief group-based presentation of findings. Instructions will have been distributed two weeks earlier.

#10 10/29 Environmental Ethics and Philosophy

Instructor: Iain Clelland

Guest Speaker: Steve Smith (U.S. Congressional Candidate)

Objective: Environmental issues involve questions of human values as well as of science. The purpose of this class is to explore moral implications of environmental issues. We will examine how a corporation balances notions of efficiency with environmental and social equity. In addition, the class will provide you with an opportunity to identify and compare your environmental values with those of others.

Preparatory Reading:

Kempton, W., Boster, J. & Hartley J. 1995. Environmental values. Chap. 5 in Environmental values in American culture. by same authors.

Jackson, J. 1996. Greenpeace gets real. Time, June 10: 53-58.

Special activity: Discussion of "Sustainable Values" and

"Environmental Attitudes" surveys.

#11 11/5 TQM and Environmental Management

Instructor: T Douglas

Objective: This session will review and update TQM's relationship to management practice. It will extend TQM to encompass environmental concerns and will present a corporate example using TQEM. Finally, it will relate this concept to real world applications and use a participative exercise to reinforce the concepts.

Preparatory Readings:

Grant, R., Shani, R. & Krishnan, R. 1994. TQM's challenge to management theory and practice. Sloan Management Review. Winter: 25-35.

Thompson, F. 1992. Statistical measures for management oversight to achieve continuous improvement at Monsanto Chemical Co. in GEMI's Corporate quality and environmental management conference proceedings: 11-17.

Special activity: Play-Doh simulation.

ADDENDUM TO SYLLABUS WILL FOLLOW WITH A READINGS SUPPLIMENT ALSO TO FOLLOW

#12-3 11/12&19 Waste Minimization/Risk Assessment -- PC (Engineering TBA)

#14 11/26 Environmental Management Systems -- Implementation

[Read TIBOR: Chps. 11-12]

#15 12/3 Group Project Presentations

1) Clayton Homes (Norris Facility)

[Project involved analysis and recommendations regarding problem involving wood waste.]

2) North American Phillips (Greenville Printed Circuit Board Plant)

[Project involved formulated position paper on State policies toward ISO 14000 and discussions of actual audit procedure]

(NOTE: There may be a distance learning conference on ISO 14000 on Oct. 24. More information will be available later.)

Educational Materials Available From the National Pollution Prevention Center for Higher Education

The National Pollution Prevention Center for Higher Education publishes many educational resources illustrating pollution prevention concepts and ideas. These materials, intended for use in colleges and universities, are organized within evolving compendia that cover a range of disciplines. This document describes all NPPC resources currently available. An order form is included at the end; prices are set to cover the cost of reproduction and postage. (Note: Most of the research publications described on page 9 are distributed by other publishers, not the NPPC.)

Compendium Components

Introductory Materials

The NPPC publishes two introductory pieces, "Overview of Environmental Problems" and "Pollution Prevention Concepts and Principles." Each complete compendium also includes a discipline-specific introduction describing relevant applications of pollution prevention.

Resource List

Each compendium includes an extensive list of educational tools and reference materials: bibliographies, books, reports, journal articles, government documents, and course syllabi and curricula. (Most of these materials are located in university libraries or bookstores; the list explains how to obtain those that are not.) Also included is contact information for relevant organizations and selected faculty active in pollution prevention education.
Full text versions of all NPPC Resource Lists are now available online! See our home page: http://www.umich.edu/~nppcpub/

Annotated Bibliography

Organized alphabetically, the bibliographies describe some or all of the materials listed in the Resource Lists.

Selected Readings

These documents (most of which are reprinted from journals) provide background information for faculty; many are appropriate for distribution to students.

Syllabi

Professors nationwide have provided their course syllabi for colleagues who wish to see examples of how to teach about pollution prevention. Strategies include discussing pollution prevention during a single class session, integrating it throughout a course, and developing a course specifically about it.

Student Assignments

Most of the compendia contain at least one case study; some also include homework, exam, and open-ended problems, which vary in scope from a half-hour exam question (see "Accounting") to an extensive design project (see "Chemical Engineering"). Most of these student assignments include teaching notes for the instructor and suggested responses to problems or discussion questions.

Videos

The NPPC has two videos available for professors to show to students. One complements the McDonald's/Environmental Defense Fund case study (see "Corporate Strategy"); the other, about a joint Amoco/U.S. EPA project (listed under "Chemical Engineering"), may be used alone.

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Introductory

Overview of Environmental Problems

This 125-page document presents a comprehensive background of the impacts of human actions on various aspects of the environment. To educate faculty and students about environmental issues; it provides background information, scientific concepts, and terminology on Energy, Climate Change, Ozone Depletion, Resource Depletion, Land Use, Waste, Air Quality, Water, and Ecological and Human Health. Included are numerous figures and tables and a glossary of terms and concepts, all of which are useful teaching tools. $19

Pollution Prevention Concepts and Principles

This 16-page document introduces the concepts, terminology, objectives, and scope of pollution prevention. It discusses how government and the private sector are currently perceiving and implementing pollution prevention and describes the barriers and benefits encountered. $3

Accounting

Introduction

Gives a brief history of environmental accounting, covering key principles and defines relevant terms. Reviews the literature, identifies current trends and issues, and describes how companies are implementing environmental accounting. Also suggests how to use compendium. $3

Resource List

Educational Tools: Four annotated bibliographies, eight case studies, four problem sets, and four course syllabi. *Reference Materials:* 35 books/reports, 75 articles, three software programs, one audiotape, one directory, nine organizations, and 11 faculty active in pollution prevention education. $1.50

Annotated Bibliography

Alphabetically lists and describes 45 relevant publications, all of which appear in the Resource List. $1.50

Course Syllabi

A collection of syllabi from university courses involving pollution prevention and accounting taught by Mark Cohen (Vanderbilt), Christopher Stinson (Texas), Donald E. Stone (U-Mass), and Mark A. White (Virginia). $7

Case Study: 3M Waste Minimization

Much has been written about performance measurement, but relatively little is known about using environmental measures in industry. This 15-page case illustrates non-financial performance measures on a manufacturing environment, allowing the instructor to focus on either environmental or performance measurement issues when several measures are being used. Includes teaching note. $2

Case Study: Replacing Ozone-Depleting Chemicals: Taxes and Decisions for a Manufacturer

(See "Finance.") $1.50

Problem Set: Overhead Allocation for Pollution Prevention

30-minute exam question addressing the proper allocation of environmental costs to products. Includes answer key. $1.50

Agriculture

Introduction

Describes the contents of the compendium and mentions the many pollution problems caused by modern agricultural practices, along with some sustainable methods that may reverse the trend. **$1**

Resource List

Organized by topic; cites 240 publications, 23 videos, a database, and two software packages. Includes contact information for 18 mentor faculty and 10 organizations that provide additional materials and assistance. **$2**

Annotated Bibliography

Alphabetically lists and describes 30 relevant publications, all of which appear in the Resource List. **$1**

Farms and Greenbelts

Describes how and why there have been massive changes in U.S. land use since 1950 and suggests how wise planning can preserve our remaining fertile soil for food production. **$2**

Conservation of Fertilizers and Livestock Manure: Pollution Prevention

Refers to 38 recent articles while discussing how to manage fertilizers, compost, and livestock manures to conserve nutrients and prevent pollution. **$2**

Course Syllabi and Curricula

Features extensive syllabus by Cornell's David Pimentel listing specific content for 14 sustainable agriculture topics and citing suggested companion articles. Also includes brief outline of Alison Power's "Food, Agriculture, and Society" course taught at Cornell and a reprint of Miguel Altieri and Charles Francis' "Incorporating Agroecology Into the Conventional Agriculture Curriculum" article, which provides a strong rationale for agroecology courses, discusses methodology and perspectives, and suggests specific course components. **$3**

Selected Readings

A collection reprinted key documents by Pimental et al. **$13**

- "Energy Efficiency of Farming Systems: Organic and Conventional Agriculture"
- "Agroecosystem Biodiversity: Matching Production and Conservation Biology"
- "Water Resources in Food and Energy Production"
- "Benefits and Risks of Genetic Engineering and Agriculture"
- "Environmental and Economic Effects of Reducing Pesticide Use"
- "Environmental and Economic Costs of Pesticide Use"
- "Renewable Energy: Economic and Environmental Issues"
- "Environmental and Economic Costs of Soil Erosion and Conservation Benefits"
- "Environmental and Economic Benefits of Sustainable Agriculture"

Business Law

Introduction

Briefly explains legal advantages of comprehensive pollution-prevention strategies; suggests how to integrate them into law curricula. **$1**

Resource List

Educational Tools: Six articles and three statutes. *Reference Materials:* 16 books and reports, 42 articles, 13 government reports and hearings, one federal statute, 27 state statutes, and three faculty active in pollution prevention education. **$1.50**

Annotated Bibliography

Alphabetically lists and describes 93 relevant publications, all of which appear in the Resource List. **$1.50**

Selected Reading Material

A collection of key documents. **$17**

- Clearwater, Scott W., & Joanne M. Scanlon, *Legal Incentives for Minimizing Waste*, 10 ENVTL. PROGRESS, Aug. 1991, at 169.
- Grayson, Lynn E., *The Pollution Prevention Act of 1990: Emergence of a New Environmental Policy*, 22 Envtl. L. Rep. (Envtl. L. Inst.) 10,392 (1992).
- Guruswamy, Lakshman, *Integrated Thoughtways: Re-Opening of the Environmental Mind?* 1989 WIS. L. REV. 463.
- Johnson, Stephen M., *From Reaction to Proaction: The 1990 Pollution Prevention Act*, 17 COLUM. J. ENVTL. L. 153 (1992).
- Pollution Prevention Act of 1990, 42 U.S.C. Sec. 13101–13109. The federal statute.
- Connecticut Environmental Assistance to Business Act, Conn. Gen. Stat. Ann. App. Pamphlet, PA 91-376 (1992). Voluntary state statute.
- Massachusetts Toxics Use Reduction Act, Mass. Ann. Laws Ch. 21I Sec. 1-23 (Law. Co-op Supp. 1992). Mandatory state statute.

A Pollution Prevention Primer for Law Teachers

Discusses pollution prevention vs. media-specific regulations and laws. Also describes current acts and federal and state programs. **$1.50**

A Chemical Engineer's Guide to Environmental Law and Regulation

(See "Chemical Engineering.") **$13**

Chemical Engineering

Introduction

Justifies pollution prevention on the bases of environmental protection as well as "bottom-line, business-minded thinking"; highlights educational resources to help chemical engineering faculty incorporate key pollution prevention concepts into courses. $1

Resource List

Educational Tools: One annotated bibliography, two case studies, two books, two collections of problem sets, 19 syllabi and curricula, and six videos. *Reference Materials:* 30 books, 45 reports/guides, 91 articles, seven case studies, six organizations, and 50 faculty involved in pollution prevention education. $2.50

Annotated Bibliography

Alphabetically lists and describes 120 publications, all of which appear in the Resource List. $1.50

Course Syllabi

A collection of syllabi from 12 university courses involving pollution prevention and chemical engineering taught by William Budd (Washington State); Pete Counce (Tennessee); Dale Denny, Michael Overcash, and Christine S. Grant (NCSU); Marvin Fleischman (Louisville); David Kidd (Alaska); Robert Pojasek (Tufts); Ronald Minet (USC); and Margrit von Braun (Idaho). $10

A Chemical Engineer's Guide to Environmental Law and Regulation

This 100-page guide gives chemical engineers a general overview of the field of environmental law. Main sections discuss (1) specific reasons why chemical engineers should understand environmental laws and regulations; (2) the roles of legislatures, administrative agencies, and courts in environmental law; (3) the interaction of environmental laws at federal, state, and local levels; and (4) relevant provisions of nine federal Acts:

- Toxic Substances Control Act
- Federal Insecticide, Rodenticide, and Fungicide Act
- Occupational Safety and Health Act
- Clean Air Act
- Clean Water Act
- Resource Conservation and Recovery Act
- Comprehensive Environmental Response, Compensation, & Liability Act
- Emergency Planning and Community Right-to-Know Act
- Pollution Prevention Act $13

Open-Ended Problem: Determining Mass Balances in Ford-Wixom's Phosphate Coating System (includes CD-ROM)

This assignment exposes materials balance students to actual processes. Student groups are asked to develop a flowchart for the Phosphate Coating System of Ford Motor Company's Wixom Assembly Plant and suggest reconfigurations that would minimize the amount of waste generated.

The main source of information is a multimedia tour of the phosphate coating system. The tour, on CD-ROM, has video clips from the actual system, a short description of each of the system's 12 stages, and supplementary explanations; students can explore the system at their own pace and in any order they wish. The CD-ROM runs on Macintosh and Windows systems. $21

System Requirements

- For the Mac, you'll need at least a Mac II — a 68020 chip is the minimum; a machine with a 68030 or higher chip (at least an LCIII or SE/30) is better. Mac users will also need at least 8MB RAM, System 7.0.1, and QuickTime 1.5 or higher (note that QuickTime does not work well with System 7.0).
- The Windows version requires a 386 or higher with 8MB RAM, DOS 6.0 or later, Windows 3.0 or later, QuickTime for Windows 1.1.1 or later (the current version is 2.0), and screen resolution of at least 640×480.

Open-Ended Problem: Design of a CFC-Free, Energy-Efficient Refrigerator

This 145-page case challenges students to design a household refrigerator that uses a non-ozone-depleting refrigerant and also is energy-efficient. Includes short discussions of issues related to the evolution of the refrigerator and the subsequent environmental threat. The proposed solution leads from thermodynamic calculations to a choice of refrigerants that, when combined with the refrigerator's specifications, will meet the design requirements. Appendices include refrigerant manufacturer data and output from a thermodynamic calculation computer program. $15.50

Case Studies: McDonald's

(See "Corporate Strategy.") $11

Case Study: Agent Regeneration and Hazardous Waste Minimization at IBM

(See "Operations Management.") $1.50

Case Study: Degreaser Replacement at Ford

(See "Environmental Engineering.") $2.50

Video: Second Victory at Yorktown

This 31-minute video examines the joint Amoco/EPA project that addressed the reduction of pollution from a petroleum refinery. The video explains pollution prevention, risk analysis, and decision-making and then then goes on to describe the expectations and concerns of each of the participants and finally the results of the project. The material is intended for survey courses on environmental issues, chemical and industrial engineering classes, and business classes on operations management and business law (voluntary vs. mandatory programs); it is also suitable for managers and engineers. $22

Video: McDonald's

(See "Corporate Strategy.") $16

Chemistry

Incorporation of Pollution Prevention Principles into Chemical Science Education

This 84-page thesis was written by a graduate student in environmental and industrial health. It begins with a review of the literature on "green chemistry" and chemical science education. Next, the author proposes a methodology for chemical life cycle analyses that can be incorporated into university-level chemistry curricula. The main section of this documents is a case study applying that methodology in a comparison of the environmental impacts of producing and using ethylene glycol-based antifreeze vs. a similar product made of propylene glycol. Includes numerous tables, figures, and appendices. **$13**

Resource List

Educational Tools: Three articles. *Reference Materials* (grouped under five P2-in-chemistry themes): 146 articles, three books, three reports, five publishers, five online services, four faculty involved in pollution prevention education, and five organizations. Includes matrix that summarizes all materials within specific categories and subcategories while also showing the intended audience level for each document. **$2.50**

Annotated Bibliography

Alphabetically lists and describes all materials cited in the Resource List. **$2.50**

Corporate Strategy

Case Studies: (A) McDonald's Environmental Strategy, (B1) The Clamshell Controversy, (B2) McDonald's Decision, and (C) Sustaining McDonald's Environmental Success

Cases A and B focus on the work of a joint task force developed by McDonald's Corporation and the Environmental Defense Fund: members addressed McDonald's solid waste management strategy and the question of whether to replace polystyrene packaging with paper wrap. Case C examines the company's reaction to public concern about the sustainability of beef production and consumption. Included are a teaching note as well as notes on life cycle analysis and solid waste issues. **$11**

Video: McDonald's/EDF Environmental Task Force

This 16-minute video accompanies the written case studies. Robert Langert, McDonald's director of environmental affairs, and Jackie Prince, Environmental Denfense Fund staff scientist, present different perspectives on the joint project. Issues discussed include reasons for and reservations about participating, organizational goals of the project, results, and advice for others thinking of pursuing similar projects. **$16**

Video: Yorktown

(See "Chemical Engineering.") **$22**

Environmental Engineering

Case Study: Degreaser Replacement at Ford Motor Company's Climate Control Division

This case analyzes Ford's pilot study of aqueous degreaser units as an alternative to trichloroethylene (TCE). Includes discussion questions and problem sets. **$2.50**

Environmental Studies

Introduction

This brief introduction provides imagery to answer the question "Why teach pollution prevention in an environmental studies class?" $1

Resource List

Lists 47 books, 24 reports, 99 articles, 6 videos, and 13 course syllabi; arranged under topics that correspond with the Bibliographic Teaching Outline. $1.50

Annotated Bibliography

Alphabetically lists and describes all materials in the Resource List. $3.50

Selected Reading Material

A collection of key documents. $19

- Mary Ann Curran: "Broad-Based Environmental Life Cycle Assessment."
- Dale Jamieson and Klasina VanderWerf: "Cultural Barriers to Behavior Change: General Recommendations and Resources for State Pollution Prevention Programs."
- John Wise: "Challenges for the Future."

Bibliographic Teaching Outline

Covers pollution prevention topics ranging from fundamental concepts to everyday applications. Written in narrative form, it follows the structure of the Resource List, to which it makes numerous references. Serves as a teaching guide for integrating pollution prevention into environmental studies courses; also helps teachers locate resources. Includes the following brief documents. $3.50

- **Suggested Course Structures.** Highlights major topics in the Bibliographic Teaching Outline to suggest how long to spend on the topics, depending on the amount of classroom time available, be it one day or an entire semester.
- **References by Academic Discipline.** Shows the relevance of Resource List materials to seven liberal arts disciplines: biology and natural resources; chemistry, physics, mathematics, and geology; economics; education; humanities; political science and policy studies; and sociology, psychology, and anthropology.

Finance

Case Study: Replacing Ozone-Depleting Chemicals: Taxes and Decisions for a Manufacturer

Asks the student, as financial analyst, to analyze options and recommend a strategy for handling a manufacturer's current inventory of ozone-depleting chemicals. Includes discussion questions, teaching note with answer key, and financial tables. $1.50

Case Study: Green Lights: Graphic Design Considers a Lighting Upgrade

A small-businessman is approached by an EPA-trained energy specialist about upgrading his five-year-old lighting system to be more energy-efficient. Students must decide whether this is worthwhile, financially and otherwise. Case includes financial tables, discussion questions, and a teaching note with answer key. $1.50

Case Study: Chrysler Corporation (A): The Jefferson North Assembly Plant

(See "Operations Management.") $2

Industrial Ecology

Introduction

Describes the background of industrial ecology, defines its main attributes, and puts it in the perspectives of an academic discipline and a field of ecology. Covers goals, key concepts, sustainable development, system tools (life cycle design, life cycle assessment, and design for environment), and future needs. $4

Resource List

Lists 153 books and articles, two collections of problem sets, two videos, eight syllabi, and 19 faculty. $1.50

Annotated Bibliography

Describes 41 relevant publications; all appear in the Resource List. $1.50

Selected Reading Material

A collection of key documents. $5

- Braden R. Allenby: "Achieving Sustainable Development Through Industrial Ecology."
- Robert U. Ayres: "Industrial Metabolism: Theory and Policy."
- Robert A. Frosch: "Industrial Ecology: A Philosophical Introduction."
- Greg Keoleian and Dan Menerey: "Sustainable Development by Design: Review of Life Cycle Design and Related Approaches."

Course Syllabi

A collection of syllabi from six university courses involving industrial ecology taught by Clinton Andrews (Princeton); Garry Brewer, Stuart Hart, and Gregory Keoleian (Michigan); William Clark, Robert Frosch, and R. H. Socolow (Harvard); and Faye Duchin (NYU). $9

Case Studies: McDonald's

(See "Corporate Strategy.") $11

Video: McDonald's/EDF

(See "Corporate Strategy.") $16

Video: Second Victory at Yorktown

(See "Chemical Engineering.") $22

Industrial Engineering and Operations Research

Introduction

Describes the inherent and critical role industrial engineers must play in developing successful pollution prevention programs. Shows how compendium contents relate to seven Industrial Engineering and Operations Research topics: (1) Capital Budgeting, (2) Decision Analysis, (3) Facilities Planning, (4) Operations Research, (5) Organizational Design/Management of Change, (6) Production Control, and (7) Total Quality Manangement. **$1.50**

Resource List

Educational Tools: Four case studies, three articles with discussion questions, one problem set, four course syllabi, and one video. *Reference Materials:* 15 books, 42 articles, four organizations, and 11 faculty involved in pollution prevention education. Includes matrix showing which resources are relevant to each of the seven Industrial Engineering and Operations Research topics. **$1.50**

Annotated Bibliography

Alphabetically lists and describes all books, articles, and case studies appearing in the Resource List. Includes matrix showing which resources are relevant to each of the seven Industrial Engineering and Operations Research topics. **$1.50**

Selected Reading Material

A collection of key documents. **$3.50**

- R. A. Frosch and N. E. Gallopoulos. "Strategies for Manufacturing."
- H. C. Haynsworth and R. Tim Lyons. "Remanufacturing By Design."
- Robert L. Kraft. "Incorporate Environmental Reviews into Facility Design."

Course Syllabi

A collection of syllabi from relevant courses by Rex T. Ellington (Oklahoma), William Clark and Robert Frosch (Harvard), Robert B. Pojasek (Tufts), and Wayne C. Turner (Oklahoma State). **$4.50**

Articles With Discussion Questions and Teaching Notes

- **Pollution Prevention and Facilities Planning.** Discusses the need for planners to consciously include environmental considerations when locating and designing facilities. **$1.50**
- **TQM: A Methodology for Pollution Prevention.** Discusses how the four elements of Total Quality Management — customer focus, continuous improvement, teamwork, and strong management commitment — can all be applied to prevent pollution. **$1.50**

Case Study: Amoco and the Environmental Decision Analysis: Cases A and B

The basis for this case is a project conducted by Amoco Corporation and the U.S. EPA at Amoco's Yorktown, Virginia, refinery: a multi-media assessment, development of options for pollution prevention, and evaluation. Case A explains a decision-analysis technique called the Analytical Hierarchy Process (AHP) and describes the Amoco/EPA criteria and options; Case B discusses the results obtained from applying AHP. Includes teaching note. **$2.50**

Case Study: Pollution Prevention as Continuous Improvement at Ford Motor Company

Describes background, process, and results of a pollution prevention study at Ford's Livonia, Michigan, Transmission Plant. Details the 13 "waste prevention opportunities" identified at the plant and outlines the main ideas of Ford's *Roadmap to an Effective Waste Minimization Program,* which has been distributed to Ford plants worldwide. Includes discussion questions (with answer key) and exhibits. **$2.50**

Problem Set: The Tragedy of the Commons and the Decision Maker

Gives excerpts from Garret Hardin's classic article, "The Tragedy of the Commons," and asks students to apply those ideas to seven homework problems. Includes teaching note with answer key. **$1.50**

Video: Second Victory at Yorktown

(See "Chemical Engineering.") **$22**

Marketing

New Compendium!

Introduction

Briefly introduces current environmental issues in the field of marketing, describes the intended purpose of this compendium, and suggests how to apply it to college-level business courses. **$1**

Resource List

Organized by topic; cites more than 200 relevant books, articles, reports, case studies, and Internet websites. Includes contact information for six mentor faculty and eight case study publishers. **$1.50**

Annotated Bibliography

Alphabetically lists and describes the "100 best" publications cited in the Resource List, including all 26 case studies. **$1.50**

Course Syllabi

Contains syllabi from environmental marketing courses taught by Mark Cohen (Vanderbilt MBA course) and Gail Kirby (Santa Clara University undergraduate course). Includes discussion questions and student assignments. **$1.50**

Operations Management

Case Study:
Agent Regeneration and Hazardous Waste Minimization—IBM Corp.

This 12-page case analyzes IBM's search for innovative solutions to a complex operational/environmental problem in a chemical etching process at its Endicott, NY, facility. Decision analysis of the alternatives is central to the case. Includes teaching note. **$1.50**

Case Study:
Chrysler Corporation (A): The Jefferson North Assembly Plant

14-page case examining the way Chrysler Corporation addressed pollution prevention in its new Jeep Cherokee assembly plant in Detroit. Includes teaching note. **$2**

Case Study:
3M: Waste Minimization

(See "Accounting.") **$2**

Video:
Second Victory at Yorktown

(See "Chemical Engineering.") **$22**

Other NPPC Resources

Directory of Pollution Prevention in Higher Education: Faculty and Programs, 1997

Updates the 1994 edition to list more than 400 faculty. Describes activities of people currently involved in integrating pollution prevention concepts into curricula; includes extensive contact information. **$20**

Pollution Prevention Strategies for College Campuses: A Case Study at University of Michigan

184-page report by a group of graduate students who conducted an environmental audit of their campus as well as detailed analyses and action plans for (1) "greening" the business school and (2) instituting a system for tracking hazardous chemicals purchased, used, stored, and disposed of on campus. Includes suggestions for students wishing to undertake similar efforts at their own colleges. **$23**

One-page executive summary: **$1**

A Comparative Study of Perc Dry Cleaning and an Alternative Wet Cleaning Process

212-page report by a group of graduate students who conducted a comparative life cycle analysis of two professional clothes cleaning processes. Findings are detailed under five criteria: environmental impacts, human health impacts, performance, economics, and regulations. Includes recommendations. **$31**

Six-page executive summary: **$1.50**

Slide Show: EPA's Comprehensive Pollution Prevention Orientation

Used in the pollution prevention training seminar for all U.S. EPA employees. Puts pollution prevention in historical perspective; uses examples to describe techniques industry can use to practice prevention; and examines EPA's pollution prevention programs. **$26**

On the Web...

Check out the NPPC Website, http://www.umich.edu/~nppcpub/ for the most up-to-date information on our publications. **Full text versions of all NPPC Resource Lists are now available on our home page!**

The NPPC and its contributors are currently developing compendia in these areas:

- **Sustainable *Architecture***
- **Pollution Prevention in the *Coastal Zone***
- **Pollution Prevention in *Finance***
- **Strategic Environmental *Management***

We welcome your suggestions and recommendations on content and organization. Please send your comments to nppcpub@umich.edu or call the NPPC Publications Department at 734/936-2637.

NPPC Research Publications

Framework and Methodology

Life Cycle Design

Keoleian, G. A. "Life Cycle Design." Chapter 6 in *Life Cycle Assessment*, edited by M. Curran, 6.1–6.34. New York: McGraw-Hill, 1996.

———. "Pollution Prevention through Life Cycle Design." In *Pollution Prevention Handbook*, edited by H. Freeman, 253–292. New York: McGraw-Hill, 1995.

Keoleian, Gregory A., Jonathan Koch, and Dan Menerey. *Life Cycle Design Framework and Demonstration Projects: Profiles of AT&T and AlliedSignal.* Cincinnati: U.S EPA Office of Research and Development, National Risk Management Research Laboratory, 1995. 127 pp. (Available free from the Center for Environmental Research Information: call 513/569-7562 and request EPA/600/R-95/107.)

Keoleian, G. A., and D. Menerey. *Life Cycle Design Guidance Manual: Environmental Requirements and the Product System.* Cincinnati: U.S. EPA Office of Research and Development, Risk Reduction Engineering Laboratory; 1993. (Available free from the Center for Environmental Research Information: call 513/569-7562, and request EPA/600/SR-92/226 for project summary or EPA/600/R-92/226 for report.)

——. "Sustainable Development by Design: Review of Life Cycle Design and Related Approaches." *Air and Waste* 44 (1994): 644–668.*

Keoleian, Gregory A., Dan Menerey, and Mary Ann Curran. "A Life Cycle Approach to Product System Design." *Pollution Prevention Review* 3, no. 3 (Summer 1993): 293–306.

Life Cycle Assessment

Keoleian, G. A. "The Application of Life Cycle Assessment to Design." *Journal of Cleaner Production* 1, no. 3/4 (1993): 143+.*

Keoleian, Gregory A., et al. *Product Life Cycle Assessment to Reduce Health Risks and Environmental Impacts.* Park Ridge, NJ: Noyes Data Corporation, 1994. 228 pp.

Demonstration Projects and Case Studies

Automotive

Kar, Krish and Gregory A. Keoleian. "Application of Life Cycle Design to an Intake Manifold." SAE Technical Paper Series 960410. Warrendale, PA: SAE International, 1996.

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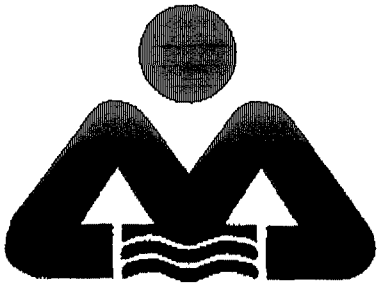

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