DESIGNING THE SUSTAINABLE ENTERPRISE

Summary Report
Second International Research Conference
The Greening of Industry Network

Cambridge, Massachusetts, USA
November 1993

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EXECUTIVE SUMMARY

This report summarizes the papers, presentations, and discussions of the conference Designing the Sustainable Enterprise, held in Cambridge, Massachusetts (USA) on November 14-16, 1993. The conference was organized by the Greening of Industry Network, based at the Center for Environmental Management, Tufts University, Medford, Massachusetts, USA and the Center for Studies of Science, Technology and Society, Apsiondoon, The Netherlands.

The conference was the second in a series convened to discuss and stimulate new research. The research reported here builds on that of the Network's first conference, whose selected papers were published as Environmental Strategies for Industry, Kurt Fischer and Johan Schot, editors, Island Press, Washington, D.C. 1993.

The goals of the conference were to (1) continue to build a network of researchers in environment, cleaner technologies, and sustainability, (2) stimulate new strategic research activity among the research community and (3) to encourage dialogue with potential users of the research. These include academics, policy analysts, industry, government, labor, and the community at large.

The main themes addressed in the conference were:

- The Meaning of Sustainability
- The Greening of Corporate Accounting and the Measurement of Sustainability
- Networks, Dialogue with Stakeholders, and the Greening of Learning
- Design for the Environment
- Pollution Prevention and Facility Planning
- Government Intervention, Market Forces, and Green Corporate Responses
- Governmental Capacity to Encourage Sustainable Development
- Industry Capacity for Long-term Futures Studies
- The Transition to Sustainability

III. Research Needs and Policy Implications

IV. Appendices

The conference focused on the sustainable enterprise, but some clarification is warranted. The concept of sustainability is necessarily a broad one. Since the firm or enterprise is connected to or affects the whole of society, research on the sustainable enterprise must include issues related to sustainable production, consumption, employment, livelihood (jobs which create purchasing power), and culture. To put it another way, the term sustainability refers more than to the environment. Further, while discussion about the sustainable enterprise tends to be centered on manufacturing, energy and services, it is important to note that sustainability also refers to extraction industries, agriculture, transportation, and information systems. Finally, the socioeconomic impact of "industrial" activity, here broadly defined to involve all the activities that are undertaken to satisfy human needs, should also be viewed expansively to include ecological systems, biodiversity and environmental justice.

Research into questions of sustainability, environmental policy and industrial policy is necessarily influenced by disciplinary orientation as well as by ideology. Economists tend to analyze problems in terms of deficiencies in supply and demand, the latter giving signals to the market. Futurists, sociologists, humanists and political scientists usually focus on needs, often without reference to market concepts. Management scientists tend to concentrate on the (efficient) management of production systems, and while they also address the management of R&D, they rarely focus on the management of technological change. Indeed, much research has focused on static analysis—making existing systems more efficient, more environmentally sound, and more humane. Changes are viewed as beneficial if they move us from the present state of the world to a better state. Yet the need to facilitate an industrial transformation, to build flexibility into institutions (i.e., creating "learning institutions") so that change can go on continually, and to transcend markets altogether are now beginning to be seriously discussed in mainstream policy debates. The learning institution is involved in mutual communication with other forms in its industry, with other industries, with other economies and with its present and future customers, communities and workers—i.e., with all the stakeholders.

Ideology and values further compound disciplinary biases. Should government pick winners, or is change best left to the private sector and the market? What policies constitute "constructive government intervention" that facilitates, but does not dictate technological change? What mix of demand-side regulatory policies establishing environmental performance standards and demand-altering policies affecting consumer preferences should be fashioned? Small and medium-sized enterprises (SMEs) might be especially encouraged for a number of different reasons: to create employment, to provide a more conducive environment for innovation (in smaller technology-based firms), or to satisfy cultural preferences for small, decentralized centers of production—even if some might be less efficient in production or environmental performance. Many market economies evolve into systems with a high concentration of (economic) power. This, of course, can have onerous political ramifications. Finally, the question arises as to whether we should focus on encouraging incremental, gradual change or encourage more radical transformations.

In a sense, formulating the solution as making the enterprise greener trivializes the enormity of the task before us. An industrial transformation may require the displacement of old technologies, industries and institutions by new ones, because in order to change, organizations must not only have the willingness and opportunity to change, but they must also have the capacity to change. SMEs may be especially important as the source of new sustainable technologies. Self-regulation by industry and "industrial ecology" may indeed, as suggested in the conference, be oxymoronic. Sustainability, in its broadest
Designing the Sustainable Enterprise

sense, may require increasing rather than further decreasing the labor intensiveness of industrial and agricultural systems—
and it may require reversing the trends towards large mega-
firms. Are traditional existing industrial firms willing to be
displaced or to become less capital intensive? Can the trends
firms towards mergers and acquisitions be reversed? Are limits to
growth in general, and decreased consumption in developed
countries in particular, consistent with the purposes of the
industrial enterprise as we know it today?

Developed countries, developing countries and the
former socialist economies in transition may have fundamentally different needs and different potentials to
change. Making enterprises greener in Poland presents a
very different challenge than creating green industries in
Zambia. Research into solutions must reflect these national
and cultural differences. Further, the goals of efficient or
rapid transition to a higher level of industrialization or
agricultural production may be in conflict with national
goals of self-reliance.

Underemployment, unemployment and poverty are all
points on a continuum. If government is the trustee of
sustainability for this and future generations, it must play a
role in facilitating an industrial transformation. It must act as
a trustee not only for the general society, but much more
particularly for the yet-to-be-created new firms and
institutions that need to be encouraged, but are not yet
represented in the market or political process. The
government must be involved in encouraging both
technological and institutional innovation, i.e., it must act as
a change agent. Some of this innovation will be incremental.

Others changes require radical departures from the ways of
the past. The mature industrial states are largely gerarchies—
that is, old industrial systems dominated by large, established
institutions and firms, perhaps created with capacities to
serve bygone needs and interests, and understandably
especially resistant to significant change. Even international
competitive pressures may not change old habits and
encourage approaches to the re-design of technological
systems. Government, SMEs and international lending
institutions/development agencies have key roles to play in
this context.

Opening up the existing enterprises to participation by
labor and by the community may be one way of factoring societal
"demands" into corporate consciousness, but the
fundamental forces of competition and short-term or
immediate need for cutting costs are powerful determinants of
what direction the enterprise takes. Further, the
demands of labor and the community adjacent to the
enterprise reflect the needs of the rest of society or its
future needs. It remains to be seen whether the enterprise
can transform itself enough, and in time, to avoid future
ecological disasters, socially disruptive displacement of labor
and economic disparities. Does clea production designed by
the firm necessarily mean lean production, displacing of
labo? The rise of an underclass within the developed
countries raises real concerns. The concept of North and
South as existing in distinct national boundaries no longer
holds. The increasing globalizations of the world economy
paints a different picture. Sustainability and the sustainable
enterprise have to be examined in an entirely different
context than a decade ago. Identifying future, rather than just
present needs (what some call "backcasting"), and facilitating
an industrial transformation to satisfy those future needs is a
different challenge than one focused on making the existing
system more efficient or green.

The published work product of the first Greening of
Industry Network conference, Environmental Strategies for
Industry (Island Press 1993), identified a number of research
needs including a better understanding of: (1) how a learning
process can transform firms from defensive, end-of-
pipe strategies to minimizing pollution, waste and other
harmful consequences of their activities to more innovative
approaches that integrate concerns for the environment with
the traditional concerns for output and profit, (2) how to
incorporate life-cycle approaches in company strategic
planning, (3) how to utilize government policies and
interventions to bring about a transformation in the firm from
a reactive or defensive posture to adoption of a more
innovative and integrated strategy, and (4) the roles of
suppliers and consumers in influencing private-sector
behavior.

Consistent with the structure used in this writing to
describe the research papers and discussions in the second
Greening of Industry Network conference, the following
organization of topical areas are suggested for future
research and conferences, including the upcoming third
conference in Copenhagen in November 1994.

1. Concepts of the Sustainable Enterprise
and the Sustainable Society

Further refinement and discussion of the dimensions of
sustainability are needed. The concepts are necessarily
evolving and they set the stage for specific research into the
definition of national and international goals and the means of
achieving them.

2. Networks for Advancing Sustainability

The examination of influential stakeholders within the
concept of networks has proven to be particularly useful.

A. intra-organizational networks
- examination of intra-firm dynamics involving
employees concerned with the design of products and
processes, the management of production technology,
and marketing strategies

B. trans-organizational networks
- involving business stakeholders (suppliers,
contractors, customers/consumers)

C. industry-community networks
- involving nonbusiness stakeholders concerned with
the practices of the firm

D. industry-worker networks (industrial relations systems)
- workers as "nonbusiness" stakeholders
- workers as sources of ideas

E. community-worker networks
- bringing pressure for environmental management

3. Information Policies to enable and empower the
private-sector stakeholders: A Help or a Hindrance?
- LCA's: what do they leave out?
- Environmental Audits: what do they leave out?
- Right-to-know: does it include information about
technology as well as risk?

4. Technology Transfer (Diffusion of technology)

- between firms within an industry (role of trade
associations too)
- between different industries
- between countries
- developed-developed
- developed-LDCs

5. Government's role in stimulating innovation
in technology, work organization, and management
(involving cleaner production, sustainable technology
and sustainable employment)
- government support for innovation
- government regulation
- economic instruments

6. Transformation to a Sustainable Society

- consideration of policies, mechanisms, and strategies
to bring about both evolutionary and radical
transformations

This research menu or agenda is suggested as a format for
both identifying future research needs and for organizing
future conference discussions.
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We wish to express our thanks to the authors of this report, Nicholas Ashford and Ralph Melina, for this perceptive analysis of the conference’s diverse themes and discussions. A team of graduate students deserve special praise for recording and summarizing the many workshops: Justin Burt, Brihgt Calimandro, Jay Goldberg, Ilse Gotelli, Maureen Hart, Christine James, Scott Kennedy, Laurent Ranvelier, Brent Omdahl, Brian Schenck, Cynthia Schenck and Carol Rouvyer. And special thanks go to Network research assistants Edith Jenkins and Jodi Sugerman for their tireless efforts since 1992 in building the Network and planning this conference, and to Beth Kozinn for conference management. We are indebted to our Network Advisors for their dedication and volunteer efforts in guiding not only this conference but the vision and mission of the Network. Thanks to Frank van den Akker, Matt Arnold, Joan Banaraz, Patricia Dillon, Thomas Gladwin, Abby J. Pinrie, Kent Portney, Sybre de Hoo, Jacqueline Alois de Landerle, Dave Rojek, Hank Schilling, Andrew Sors, Harry Spaan, Ulrich Steger, Philip Vergragt and Richard Welford.

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Finally, we wish to thank all of the conference participants for making the conference a success and for helping to build the Network.

Kurt Fischer and Johan Schot

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INTRODUCTION

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Underemployment, unemployment and poverty are all points on a continuum. If government is the trustee of sustainability for this and future generations, it must play a role in facilitating an industrial transformation. It must act as a trustee not only for the general society, but more particularly for the yet to be created new firms and institutions that need to be encouraged, but are not yet represented in the market or political process. The government must be involved in encouraging both technological and institutional innovation, i.e., it must act as a change agent. Some of this innovation will be incremental. Others changes require radical departures from the ways of the past. The mature industrial states are largely geocentric, i.e., old industrial systems-dominated by large, established institutions and firms, perhaps created with capacities to serve bygone needs and interests, and understandably especially resistant to significant change. Even international competitive pressures may not change old habits and encourage approaches to the re-design of technological systems. Government, SMEs and international lending institutions/development agencies have key roles to play in this context.

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TRANSCENDING THE FIRM INTO A SUSTAINABLE ENTERPRISE

As discussed in the Introduction to this report, policies aimed at making the enterprise greener trivializes the enormity of the task of moving towards a truly sustainable economy. While we discuss the greening of corporate accounting and the greening of learning below, these activities should be viewed as necessary but not sufficient elements of a more comprehensive and deeper commitment to change. Sarah Clarke and Nigel Rooine put it well.

"Sustainability is predicated on a radical transformation of existing techno-economic systems. A sustainable economy is not simply a reengineering of current technological systems alone. It entails change in the networks of relationships within which they exist, and the fundamental mechanisms which have been used hitherto to stimulate innovation." An industrial transformation may require the displacement of old technologies, industries and institutions by new ones, because in order to change, organizations must not only have the will to change, but must also have the capacity to change.

A. THE GREENING OF CORPORATE ACCOUNTING AND THE MEASUREMENT OF SUSTAINABILITY

Central to the issues of greening and sustainability are the definition, measurement, and reporting of environmentally-relevant data pertinent to the operations of the firm. In view of the task of designing and implementing a sustainable enterprise, it is necessary to answer such questions as: how is a firm not sustainable, at what rate and in what direction is it moving, and what changes must it make to become sustainable? Both (1) the environmental consequences of a firm's activities, which include public health and ecological effects, and (2) the environmental performance of the firm, i.e., the extent and effectiveness of the actions that mitigate its environmental consequences, must be considered. Environmental consequences and performance can be defined and measured in many ways; how this is done is essentially a matter of technique and routine. Questions of relevance to business strategies, policy makers, and researchers are: who wants the information, and why, and to what use can the information be put? The answers then guide the determination of what, how, and when information is presented to the myriad stakeholders engaged in the economy.

Peter James proposes a typology of eight different categories of what he calls "environmentalists," ranging from impact and substance measurements (what we regard as measures of environmental consequences) to implementation, efficiency, financial, customer, normalized, and aggregated measures (all corresponding to our notion of environmental performance). In approaching the question of who wants environmentics, and in what forms, we find that a great deal of such measurement and accounting, and the reports they generate, are motivated by complex institutional interests.

According to James, there are five primary "drivers" of environmentics: the need to control costs, Total Quality Management (TQM) program statements, community demands, investors, and standardization. We will add a sixth: the demands of regulators. In addition, a more general motivator among greening firms is the desire to stay ahead of strict compliance by a certain margin, and perhaps exploit this margin to obtain competitive advantages. Environmentics and reporting must therefore address the interests of all stakeholders involved with the fundamental management and reporting present highly challenging informational demands. Green accounting, environmentics, and the measurement of sustainability are all important components.

Recalling James, one notes how the drivers of the development of environmentics all present significant management challenges, and how it is in such challenges is with the help of management systems. One thread at the conference thus involved the design and role of environmental management systems (EMS) and their incorporation of various environmentics. Presenters emphasized the usefulness of a management-systems approach in integrating environmental policy goals with other business operations. Many system concepts were presented.

At their simplest, attempts at systematization take the form of tools for decision analysis, such as evaluation of alternative product designs and capital budgeting. Life-cycle analysis (LCA), for example, is a typical tool for product and program management. LCA describes a number of advanced practices at Volvo, such as the EPS, ELU, and MOTIV LCAdatabase tools. EFC is being developed by a collaborative network of Swedish industrial companies. In contrast, and foreshadowing many discussions of networks and institutions discussed below, Peter Groenewegen, Frank den Hond, and Eric Jan Tuininga criticized the usefulness of the LCA in Dutch packaging industry and find that this instrument is often highly susceptible to diverging interpretations and exploitation for political goals. A lack of standard environmentics, a discontinuity between the social and the scientific measures, and opposing social interests have lead, on the one hand, to the widespread use of LCA in the public debate, and on the other hand, to assessments of highly questionable accuracy and value. LCA is a hostage of its fragmented creators. They suggest that LCA is currently more a confessional or public opinion mechanism, for example, within an intra-organizational network, and best integrated into a broader environmental management system.

Many have criticized traditional accounting and capital budgeting techniques for chronically and systematically undervaluing future versus, present consequences and non-monetary economic variables monetary and human effects. A consensus is emerging that such tools and systems must be at the very least incorporate the Total Cost Accounting (TCA) and Cost-Facing-Accounting (CFA) approaches, which basically means that they must include not only conventional financial accounts but also all relevant consequence- and performance-environmentics. Given somewhat against this consensus, Anja de Groene and Job de Haan describe their development of a cost-benefit instrument for SME's which, they claim, need not be as complex as TCA to achieve reasonable results. Their tool is based on five performance-environmentics inspired by the value-chain, and limited to monetary costs internal to the firm.

A strong point of TCA/FEA is Daniel Rubenstein, who argues for the application of a broad array of consequence- and performance-environmentics over a long time-span. The implementation of such a sustainable corporate model must, he says, consider the entire living ecosystem with which it interacts. In addition to business goals, ecological, political, or ethical goals need also be served. Allen White takes a similar approach, clearly elucidating various factors and concepts within TCA and emphasizing their importance to capital budgeting. He presents a simulation case in which, by applying TCA, a clean technology successfully competed with traditional methods of water filtration that were in common use. White believes that radical new technologies will only replace polluting technologies if the TCA-approach is adopted.

Olof Zaring, adopting a welcome critical tone, underscores that in many companies' total capital budgeting techniques in a particularly environmentally-sensitive industry, petroleum extraction and refining, taking an environmentally-acceptable approach for such concepts as bounded rationality, organizational rationalities, garbage-can theory, and various theories of strategic planning) he finds that corporate staffs, using formal planning techniques, seldom exclusively determine capital investment outcomes, and that non-rational, institutional processes lower in the organization, especially among technical managers and accountants, determine most trade-offs and organizational choices. Environmental staffs usually succeed in formulating incremenial, "innocuous" alternatives, and choosing the path of strict, low-risk compliance.

Moving from tools for specific decision-support, we turn to assessment of the business organization as a whole. This essentially means eco-auditing. The basis idea of the eco-audit is to conduct a comprehensive review of selected environmentics at regular intervals, and to compare current to prior, budgeted, and future expected environmentics. The public demand, and on the other hand, to assessments of highly questionable accuracy and value. LCA is a hostage of its fragmented creators. They suggest that LCA is currently more a confessional or public opinion mechanism, for example, within an intra-organizational network, and best integrated into a broader environmental management system.

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envirometrics which reflect physical transformation of resources by the organization over complete life-cycles. The SDR system therefore accounts for and monitors these indicators using data from throughout the project. A failure analysis demonstrates that the ability to communicate effectively at all levels within a project leads to success.

Sustainability-envirometrics may represent many different levels of scale and scope. At one level, a single type of industrial process might be considered unsustainable. At another, a broad collection of policies, practices, and products of a firm, an industry, or even a nation might be deemed unsustainable. Different sustainability-envirometrics might be developed to address all these possible levels, in both quantitative and qualitative terms. One such conceptual technique for discussing sustainability-envirometrics is the consideration of terra inculta as a benchmark. (Terra inculta means "scrubland or unspoiled earth.") Thus it may be worthwhile to consider how one object of sustainability-envirometrics, terra inculta, might be used as a benchmark, probably sustainable by a wide margin, so it is often not meaningful to speak of the sustainability of a single firm or product using this benchmark. Yet this can be misleading because serious effects on the biosphere may result from the cumulative effect of many small contributions, each of which is negligible. Certainly, the release of CFCs from a variety of industrial sources is of this nature. Thus the question of sustainability must be seen in terms of either the current world-wide scale of operation or use of a product, or in terms of its complex interaction with other practices, products, and processes. Put another way, a sustainability-envirometric for a specific process, product, or context in society which is not accounted must address either the question of scale or that of synergistic effects.

At a simple level, two common consequence-envirometrics are COD and BOD - chemical and biological oxygen demand - used to measure the oxygen consumption of chemical reactions and bacteria in wastewater treatment. The decision of whether to use these was also used. Rubenstein, for example, suggests that it is enough to consider two future generations. All these definitions are extremely broad and vague. A question once left unanswered is: what is to be sustainable? Economic growth, current standards of living, quality of life, or ecosystem integrity? However defined, the goal and the evidence of sustainability must require more operational definitions and concrete methods of measurement. Therefore, if consequence-envirometrics seek to measure the impacts of firms on the ecosystem, and performance-envirometrics in turn seek to measure the relationship between environmental consequences and business practices and performance, we are then logically inspired to introduce a third metric: sustainability-envirometrics, or measures of sustainability. These must consider the information contained in consequence-envirometrics in relation to what the ecosystem can sustainably bear, and furthermore link sustainability consequences to the business and technological practices which cause them.
B. NETWORKS, DIALOGUE WITH STAKEHOLDERS, AND THE GREENING OF LEARNING

Clarke and Roome's discussion of different kinds of networks provides a useful way to think about the greening of learning. They argue that the ability of organizations to learn from networks influences the management and development of "environmentally sensitive technology." Networks can exist within the organization (planning, production, and innovation functions), between firms in the value chain (suppliers, contractors, and customers), and with other organizations (public interest/community-based groups). These can be informal, intra-, and supra-organizational networks respectively.

Networks can serve a number of purposes. (1) Provide internal sources of technical ideas and information, (2) provide technical ideas and information from sources external to the firm, (3) create performance requirements/constraints or provide information about market demand and opportunities, and (4) provide a means to advance shared decision making with those external to the firm by intra-organizational networks. Purposes (2) and (3) are served by both trans- and supra-organizational networks, while purpose (4) is served more specifically by customers, suppliers, and competitors. The latter two have been termed "non-business stakeholders," although in a sense workers could also be conceived of as being in this category. These networks are involved in the management of the production decisions or decisions about the choices of technology in the firm. Indeed, Clarke and Roome use the term "collaboration" in their work, primarily referring to the role of the two. While networks provide information relevant to market demand and only peripherally consider their role in shared decision making that can impact on network design, it is important to see the networks themselves in the network. Their assessment of Volvo's effectiveness is very positive. We pose a research question here: when is the intervention one of the organization's manager of a radical, deep-cultural change, and when does it instead promote incrementalism and accommodation in the place of true institutional evolution?

Within networks, often packaged under headings we identify as ideologies, belief-systems or paradigms, sometimes see on a large scale as they are more deeply embedded in the organization. Henningsen, a manager of a radical, deep-cultural change, and when does it instead promote incrementalism and accommodation in the place of true institutional evolution?

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can be found to ensure the future sustainable operation of the firm. Solution-oriented strategies can provide three types of competitive advantage: (1) play the game better so the firm can get ahead, (2) change the rules of the game to the firm’s advantage thus leading to growth and strategic influence, and (3) create an entirely new game (or inventing) with a new focus to the renewal of the core business. Three different mindsets characterize companies’ responses to environmental challenges: (1) companies, community involvement, and (2) market-based business development. Firms with the latter two mindsets tend to be more innovative, solution-oriented, and stakeholder-based. They also learn how to predict and lead the market change.

Unlike consumers, members of communities (part of the supra-organizational network) are non-business stakeholders. Yet community groups are potentially important partners in transforming the firm into a sustainable enterprise, even though the experience to date has not been particularly encouraging. This experience includes (1) company communication about plant-based risk to the surrounding community (Ches et al.), (2) industry-created citizen advisory panels (Lyman), (3) government mandating pollution education committees (Rest and Krimsky), and (4) the negotiation of “good neighbor agreements” between plants and the community. Unlike the firm, which tries to speak with one voice, there are important differences in the values and conflicts between various constituencies within the community. Not only are there likely to be different community interests, but work practices in an industrial facility may have unique concerns.

Kathleen Rest and Sholimo Krimsky reported that the participants on local environmental committees (LEPCs) focused on emergency response in the event of chemical accidents and they were not interested in promoting activities for risk reduction or for either pollution or accidents. Thus, by definition, changing the fundamental technologies of production was not a high priority, even for citizen participants. Similar to the concept of “exemplary” risk communication efforts by companies that entailed regular communication from company to community and involved citizens in reporting offensive odors emanating from the plant, this did not involve the community in decisions about production or environmental control. While this experience did involve “two-way” communication about planning related to the application of cleaner technologies; networks on higher levels are weaker, little true collaboration seems to be emerging. Strategic management of network learning is rare. This is similar to what Susanne Osland found, and is in contrast with the view that broad movement of new ideas and paradigms, culture-shift on the supra-organizational network level is having the strong, rapid impact on practices which other researchers maintain. Ben Aon also arrived at similar findings regarding the signing of metal-plating and pulp & paper companies. Reinforcing Winn, she cites the importance in decisions of key actors in the company, those who influence developments in an informal, unstructured way, driven by both regulatory and market concerns.

Consumers are important stakeholders to companies and comprise a part of the transnormative discussions. Greener consumers may be concerned with a number of attributes of the products made by a particular company including (1) whether the product is manufactured in an environmentally sustainable way, (2) whether its use is energy conserving, (3) whether its disposal is environmentally acceptable and (4) whether the manufacturing (or disposal) of the product is unhealthy. Directly assessing or verifying claims of being environmentally friendly or being a green product, however defined, is difficult. Although consumer information campaigns might have a role to play in this respect, it is also true that, unscrupulous, some companies can unjustly exact a premium for an allegedly green product. For a long time, eco-labelling might solve this problem if the labelling process is closely scrutinized. Unless there is quantitative labelling (like energy efficiency ratings), green labels will not be protected from eco-labelled alternatives. However, as the discussion of LCAs above addressed, products can be made to be better or worse depending on how the question of environmental impact is framed. For example, the issue of worker impact is often left out of the assessment, resulting in trading better "environmental" performance for worker endurance. The paper by Sebastiao Brusco and Alberto Costica discusses some of these issues in the context of Europe and in Italy where voluntary agreements between government and manufacturers provide that the latter invest in environmental improvements in order to foster media publicity enhancing the firms’ environmental reputation.

Although there was a generally positive assessment of the role of intra-, trans-, and supra-organizational networks in the greening process, there were a number of skeptical voices. Participants stated that the creation of three Swedish industries to new CFC regulation, that established contact networks between industrial buyer, raw-material suppliers, and related regulatory and industrial associations have had problems in learning and this lack of learning is important for policy-oriented reasons. Despite these initial problems, collaborative strategies are expected to lead to closer resource dependencies and institutional forces.

In the final panel, the development of EU-level carbon taxes, Tony Llyon and Jim Skaa found great institutional inertia, antagonisms, and possibilities for implementation of sub-optimal regulations. One major problem lay within government. Politicians and bureaucrats in Brussels do not communicate; politicians refused to take initiative, and bureaucrats had little legitimacy with business. As a result, a non-command & control, market-based regulation—supposedly in the new spirit of cooperation with business—came into being. The principal features designed by business, and yet was met by a confrontation with industry. Here too, established relationships and network inertia hindered organizational innovation and interfered with learning.

C. DESIGN FOR THE ENVIRONMENT

Although the detailed description and evaluation of specific environmental management tools was not a primary purpose of the conference, participants of one workshop examined the Design for the Environment (DFD) movement, and its broader regulatory and management implications of a number of tools used in the design process. Speakers focused on the product life-cycle orientation, systems-awareness, optimization and trade-off problems, and institutional and public policy factors inhibiting or encouraging DFD.

The issue of design trade-offs is particularly difficult, as it reflects the dynamic nature of the design process, and stakeholder-neglect complex of product design, where attributes that attributes should be optimized? Who decides? What do customers and regulators want? What is most profitable? Who decides all these things and sets the overall balance? For example, recyclability must sometimes be traded-off against product-life length. And, less-recyclable plastics are often more environment-friendly in vehicles, due to their lighter weight. Occupational health and safety versus environmental quality is another important possible trade-off. But even more significant is the fact that design tends to focus on overall design strategy, existing technology rather than on designing and implementing new ones. Indeed the Design for the Environment Program of the U.S. Environmental Protection Agency’s is one such program.

Given the difficulty of the designer’s task, regulators and other institutional actors (like industry associations and standards bodies) who do all they can to encourage longer-term innovation that could improve or create the trade-off problems. General encouragement, like national awards programs, is of course motivating, but is alone not enough. The need for universal acceptance, the need for technical and technical standards, the need for recycling strategies and commitments to recycling infrastructures, the need for recycling and recycling and recycling legislation. The need for recycling and recycling and recycling legislation and recycling and recycling and recycling legislation. The need for recycling and recycling and recycling legislation.

To a great extent, the fundamental issue of the support of innovation at all levels of network interaction is being
eclipsed by incremental risk-reduction, the pursuit of social legitimacy, and the commercial viability of technologies. The presence of unclear national policy goals; inadequate or inappropriate regulation; various market incentives; conflicting demands by customers, employees, activists, and other stakeholders; and the processes of standardization and the spread of professional norms all together create a perfect breeding ground for uncertainty, conservativeness, and incrementalism in R&D.

Unless a firm has a dominant position in its industry and can alone precipitate sudden change (as was the case with DuPont and CPC's), it must literally sell to its governments to see its technology; or innovation can progress at a pace sufficient to achieve "escape velocity" with respect to the requirements of a transformation to sustainable, radically-advanced technologies. This might involve, for example, outright bans or phase-outs of certain materials or pollutants emitted during production or use, or minimum energy-efficiency standards for products.

Without such measures that create market niches and opportunities, (1) substitutable-factor markets, (2) the ambiguous and complex nature of corporate stakeholders, and (3) the cognitive limitations and conflicting interests of corporate managers and designers will favor incremental, innovative solutions, with possibly higher long-run social and environmental costs.

D. POLLUTION PREVENTION AND FACILITY PLANNING

Many students of business and the environment have proposed typologies of corporate environmental performance or pollution prevention. However, these typologies are not exhaustive and represent a kind of technology-empirical way of beginning with (1) uncontrollable emissions/absence of any provision for waste treatment, (2) on-site pollution prevention and pollution prevention in a facility, (3) pollution prevention and pollution prevention in the facility. However, many studies suggest that, when programs are voluntary, even the low-hanging fruit may be ignored; collateral benefits will not be realized to the end-users of pollution prevention. However, more rigorous questions are manifest in the re-examination of preconceived notions. They also noted that progress can be very uneven, with incremental gains, sudden jumps, and tectonic plateaus. As firms experiment and gain experience, the collateral benefits of pollution prevention will become more clear.

Should pollution prevention plans and facility-wide planning for waste reduction involve mandatory Environmental Protection Agency requirements? The answer is complex. Should pollution prevention plans and facility-wide planning for waste reduction involve mandatory Environmental Protection Agency requirements? The answer is complex. Should pollution prevention plans and facility-wide planning for waste reduction involve mandatory Environmental Protection Agency requirements? The answer is complex. Should pollution prevention plans and facility-wide planning for waste reduction involve mandatory Environmental Protection Agency requirements? The answer is complex. Should pollution prevention plans and facility-wide planning for waste reduction involve mandatory Environmental Protection Agency requirements? The answer is complex.

Pollution prevention as we know it today has existed since the late-1970s, but only since the mid-1980s has it expanded at significant rates. Much of its expansion is a result of the need for new discoveries by the firm of "low-hanging fruit" ready to be picked, but rather as a result of state intervention. In an environment of regulatory standards and/or pollution prevention plans (previously required in 14 US states). Despite the often external deployment of the government's regulatory intervention, pollution prevention is usually a function of internal management and cultural attitudes and competencies.

An early voluntary internal firm pollution prevention plan was the now legendary Pollution Prevention Pays (PPP) Program at J.M. Corporation, established in 1975. A more recent example is the "Triple bottom line" introduced by the Environmental Protection Agency (EPA) and the state of Massachusetts. These programs are based on the idea that the firm, in addition to making a profit, should also be socially and environmentally responsible. However, the success of these programs has been mixed, with some firms achieving significant reductions in pollution, while others have struggled to implement effective pollution prevention strategies.

Remedies. A second, the firm perspective, has its basis in traditional management science and economics and is mainly occupied with how firms respond to and affect various aspects of their internal and competitive environment. This makes it the logical approach for the emerging discussion about green corporate strategy and environmentally-based competitive advantage. However, the traditional perspective is often criticized for its narrow focus on short-term financial gains and neglecting broader social, environmental, and ethical considerations.

Governments and industries are increasingly aware of the importance of sustainability and have implemented various strategies to promote pollution prevention and green business practices. However, it is important to recognize that pollution prevention and green business strategies are not mutually exclusive. In fact, they are complementary, as both approaches aim to reduce negative environmental impacts and promote long-term sustainability. Therefore, governments and industries should adopt a holistic approach by integrating pollution prevention strategies with green business practices to achieve the desired goals.
Designing the Sustainable Enterprise

conditions for oligopolies and monopolies to flourish. Social, regulatory, economic, and business welfare/efficiency must now be co-opted. Profits and innovation are now seen as necessary factors of success for regulation. Consequently, issues are ever more closely intertwined. Nadal believes that these shifts have presented government and industry with great challenges; only the stronger firms are beginning to organize themselves at the EU level to manage this new situation. One benefit of this has been increased communication with regulators, and the making of industry science-based regulations.

Also focusing upon regulation in the EU context, Susie Georg takes up the case of the general mix of environmental policy instruments in Denmark. Noting a shift in management from regulation, i.e. toward a more proactive and positive stance, she addresses regulation as an important source of influence. During the past ten years, there has been a move from first-generation instruments (i.e., science-based emissions standards) toward second-generation instruments including technology-forcing standards, eco-labelling, voluntary agreements with industry, and various economic incentives, reflecting an overall transfer of emphasis from pollution abatement to pollution prevention. The range of policy has become broader, and hence more flexible, in line with developments in other EU countries. What has motivated this shift? What arguments can be used for seeking to increase them further?

Georg discusses the roles of various actors in the regulatory shift, and finds that neither traditional neoclassical economic assumptions of rational actors and maximization, nor new social structure and values are much help in explaining what has happened and why the trend points toward greater flexibility. In contrast, a sociotechnical approach seems promising for understanding changing social values and notions of responsibility, and why governments and industry collaborate, and the importance of networks and learning in general are growing. Moreover, Georg confronts Nadal with the conclusion that, in this new regulatory regime, it is not mainly industry profitability, but rather inter-firm and inter-organizational exchange which regulators must encourage in order to stimulate innovation. She maintains that it is diverse, flexible instruments which can support sustainability.

Much of her analysis is supported by Mathieu Glachant, who, in focusing on the use of voluntary agreements (VAs) among firms and between firms and government as part of its flexibility and breadth—finds that the negotiation processes which VAs engender contribute to the efficiency of regulation and help to promote the self-policing and evaluation of industrial innovation. His approach is clearly economic, rather than sociological: the efficiencies are informational and cost-allocative. We note that VAs are currently referred to in the Dutch literature as "convenant" (see Groenewegen et al.).

Looking at the United States, Barbara Atman examines various VA programs in the United States, particularly the Financial Protection Agency, including the Green Lights, Golden Carrot, and Energy Star partner arrangements with various manufacturing sectors. Her approach is like Georg's, essentially sociological, looking at the evolution of government-industry networks in terms of organizational behavior and collaborative social problem-solving. Although a policy of "light" regulation, it moves from simple enforcement to foster better, faster, and more efficient industry. It, therefore, goes without saying that an active, well-qualified government must play a central role in a dynamic policy regime which pursues innovation-based national and international competitiveness. It also goes without saying that such a regime is highly compatible with sustainable development and contributes to the formation of a competitive context in which environmentally-integrated firm strategy becomes highly valuable.

With H. Landis Cabot and Bernad Sinclair-Desgane, we explore various U.S.-based industrialization approaches to a highly firm-oriented, intra-organizational, principal-agent interpretation of what they term "organizational failure." Drawing parallels between public and corporate policy, they note that even the "low-hanging fruit" among potential energy efficiency and environmental performance investments is often overlooked by corporate managers. Opportunities to economize are not taken. Moreover, environmental regulations are often violated, in direct contradiction of even the firm's own policies. The neoclassical model of the firm as a rational profit-maximizing production function is clearly not adequate when presented with such two common forms of organizational "failure." The internal environmental regulations of the firm cannot be explained, in view of what is actually observed, as simply the unusually frequent occurrence of stupidity, blindness, and laziness. The authors develop a model based on the objective functions, incentive structures, monitors, costing, distribution, of decision-making authority, and the self-interest of regulatory, corporate, consumer, and employees, and suggest that the causes of such organizational failures lie in a large disparity between the ambitions and tone of corporate environmental policies and the actual performance and effectiveness of the management instruments used for implementing them. Both currently predominant instruments and academic theories of internal corporate regulation tend to grasp the dynamics and interactive nature of the challenge, and the resulting corporate response is more typically systematically mistaken than green. Gabel and Sinclair-Desgane's propose a program of research and model-building using the organizational economic (or new institutional economic) approach with the aim of developing the management instruments necessary to make corporate environmental policies achievable.

Addressing basically the same question, this time posed in terms of why so many firms pass up seemingly obvious ways to save or make money through energy-conservation investments, Steven DeCanio pins responsibility on inadequate decision-making tools, a lack of awareness and attention, the pursuit of individual interests (also emphasized by Gabel and Sinclair-Desgane), and the general noise caused by rapid technological change. He notes that the accidental, lucidizing potential of a new institutional economic analysis as a guide to both regulators and corporate managers. More fundamentally, support for energy-saving innovations must be institutionalized.

While Gabel & Sinclair-Desgane and DeCanio locate the predilection to overlook the "low-hanging fruit" within the firm's culture, Kathleen Sullivan and Susan McNulty explore a variety of internal and external influences. Adopting an evolutionary perspective on the birth, growth, proliferation, and decline of business, they emphasize a variant of the early stage which they call "extended gestation." They avoid a pure deterministic interpretation, yet see this metaphor as widely relevant and as a framework for explaining why many energy conservation and renewable energy businesses seem to remain in their beginning phase. In line with other theorists, gestation is explored cognitively, sociologically, and ecologically, and industrial economic terms. Two propositions, based on a series of interviews with experts, are developed: one that unbridled gestation process for CSR and (2) advanced energy businesses face great uncertainty. The authors identify three factors—substitutes cost and quality, government policy, and consumer interest—which will strongly affect future growth. They suggest an extremely limited list of challenges which firms must face in order to properly launch the conservation/renewable energy industry.

F. GOVERNMENTAL CAPACITY TO ENCOURAGE SUSTAINABLE DEVELOPMENT

While government intervention through regulatory and economic measures may be directed at changing short- or medium-term responses that orient firms toward sustainability, it is clear that a model also has an important role in the fostering of a long-term vision for technology development and utilization. To the extent that firms do not recognize or pursue their own long-term interests, there is need for government to stimulate firms to do so. Short-term planning, the distortions of end-of-pipe incentives, and tendencies of firms to favor incremental improvements over radical changes require new kinds of partnerships between industry, government, labor, academia and the community to develop a sustainable economy. Life cycle analysis and management based on current needs and capabilities will not reveal opportunities and options for attaining a future. Although technology options analysis (TOA) undertaken to identify opportunities is developed. Philip Vergragt describes an ambitious multi-ministerial governmental five-year program begun in 1993 in the Netherlands conceived as a Sustainable Development Atlas (STDI). The initiative focuses on a three-pronged approach addressing problems of culture, technology, and technology. Rather than focusing on culture, the project has evolved into a search for solutions on how to achieve a different future than the present technological trajectory seems to be taking us toward. The first step is to establish an "awareness" phase to bring a sense that "back-casts" must be changed in order for society to meet those needs. Then existing unsustainable practices as well as the structural and cultural aspects of those practices the sustainable society are identified. Finally, the realizable technologies in need of development for the future are identified.
technologies are not defined in terms of products, but rather in terms of socially-valued functions such as transportation or national defense. This is more than a paper study. It seeks to engage industry, government and other stakeholders in a communication process that will launch these technological developments that lead to a sustainable society. The program can be seen as a practical experiment to influence existing networks [see discussion above] and to create new ones.

Industry's ability to do long-term product planning (see the discussion in the next section) is dependent on a series of long-term business strategies and environmental performance requirements that will exist in the distant future. Jacqueline Cramer and M. Selli address this need in the paper on "Managerial decision-making in a union bargain with union representatives, it is the workers who represent whose needs must be met, and, assuming that the benefits in the cases of productive survival and future things are presented to the union. In strong contrast to this, while much that goes around environmentally-related business issues is social in nature, the entity which environmentalists and regulation represent is Nature, whose requirements—ecosystem health, biodiversity, tolerable losses, regenerative capacity, etc.—are not social at all in the strict sense of the word. There can be no anthropocentric negotiation with the biological/ecological fundamentals. And since we do not yet know what levels of industrial activity are sustainable, nor how far short of or beyond the tolerances we currently are, about the only basis we have for forecasting future constraints is a rough rule-of-thumb that the ramp Project was launched at its present pace is not far from the line of today, and that we will not become unambiguously aware when we have done enough.

According to environmentalists, while the potential for great difficulties for business forecasting, separating it from other less problematic economic and social variables like sales growth and changing product technology. But, added to its inherent problems, the need for projecting environmental demands on firms is in fact growing explosively. The need to adequately plan future environmental products. The wood products industry has had a series of environmental pressures, such as increased energy use and policy, transport-related environmental problems, land-use planning, climate change, and sustainable development as the most important of 34 issues. The project also identified certain industry practices that are necessary and desired environmental problems, policies, analysis and technology that were necessary to address the future environmental problems. The need to identify those policies, and standards that are necessary, and environmental, or transport and land-use planning was emphasized, as was the need for increased policy clarity and consistency, and more technical standards, and standards and deadlines. The largest challenge was articulated to be the integration of environmental goals and economic development.

**G. INDUSTRIAL CAPACITY FOR LONG-TERM FUTURE STUDIES**

One of the most distinctive features of environmental concerns from the strategic perspective of the firm is that the constraints—effluent and emissions standards, waste disposal costs, energy costs, etc.—keep getting tighter and tighter, with no certain limits in sight. In the case of most social issues which have challenged businesses, such as child-labor laws and worker health & safety regulations, changes have been accepted and integrated as new norms and the pace of change has slowed to marginal, incremental improvements. Society is socially and technologically negotiated, and when the side which makes demands receives some satisfaction, the negotiation is settled, for the time being. At least, there is some sense of process and of some common ground in this negotiation, and to have access to information about the other side’s demands, expectations, and intentions. Environmentally-related social change is not negotiable in the narrow range of business strategy and government planning. A scenario analysis of environmental negotiations with union representatives, it is the workers who represent whose needs must be met, and, assuming that the benefits in the cases of productive survival and future things are presented to the union. In strong contrast to this, while much that goes around environmentally-related business issues is social in nature, the entity which environmentalists and regulation represent is Nature, whose requirements—ecosystem health, biodiversity, tolerable losses, regenerative capacity, etc.—are not social at all in the strict sense of the word. There can be no anthropocentric negotiation with the biological/ecological fundamentals. And since we do not yet know what levels of industrial activity are sustainable, nor how far short of or beyond the tolerances we currently are, about the only basis we have for forecasting future constraints is a rough rule-of-thumb that the ramp Project was launched at its present pace is not far from the line of today, and that we will not become unambiguously aware when we have done enough.

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The author describes the project’s impact by stating that the project has been useful in identifying the key issues and has provided a framework for future research. The project has also helped to raise awareness among policymakers and industry leaders about the importance of addressing environmental challenges in the long term. The author suggests that the project’s findings can be used to inform future policy decisions and to guide business strategies.

The author also notes that the project has faced some challenges, including difficulty in obtaining funding and in engaging stakeholders. However, the author believes that the project’s success demonstrates the value of interdisciplinary collaboration and the importance of long-term thinking in addressing complex environmental issues.
DESIGNING THE SUSTAINABLE ENTERPRISE

that firms are opening up to outsiders. Arun Kumar articulated a somewhat different vision of the sustainable enterprise. Against a global environment of growing unemployment, rising inflation and uncertainty in purchasing power, he argued that the central purpose of the sustainable enterprise should be to promote "sustainable livelihoods" through the creation of jobs and resulting purchasing power. The concept of "sustainable livelihoods" could be important but investors that broaden their view of productivity may indeed be more important for the creation of new enterprises. She also noted the potentially powerful role of B Corps and how corporations could have in fostering sustainable development in the developing world by bringing both appropriate technology and environmental management principles into developing countries.

The CERES Principles (formerly the Valdez Principles) is an industry-endorsed code of environmental conduct drawn up by the non-profit membership organization, the Coalition for Environmentally Responsible Economies. The ten principles themselves relate mainly to environmental, health and safety concerns, with two addressing energy conservation and the sustainable use of energy and natural resources. The corporations who sign on are expected to follow the principles in all of their operations worldwide. The Code is voluntary and non-binding, and there is no apparent mechanism to monitor, police, or enforce corporate adherence. Nonetheless, Bellamy argues that the Code constitutes a good beginning by obtaining top corporate commitment, that public scrutiny of a particular company's failure to comply provides some accountability, and that by not putting a firm under a legal deadline, realistic time is provided to improve environmental performance. Besides, the principles are intended to be used as corporate guidelines, not as substitutes. Critics suggest the Code came into existence to follow more stringent regulation, by improving the performance of laggard industries, rather than leading the way and provided as one definition of a "green corporation," but probably not a sustainable one in the sense of the discussion above.

The views of the sustainable enterprise voiced by these speakers and commentators, though different, reflected a view from the corporate in terms of its mission and willingness to act non-benevolently. The work of Hall and Ingerson discussed earlier which places the concept of sustainability within dynamic network relationships. Ultimately, there is a question of whether the corporation can change by reacting to or other stakeholders so much as whether stakeholders (suppliers, customers, consumers, workers and the community) will allow the corporation to exist in any traditional terms. The strategic implications of these are clear: protection of the firm's "license to trade/license to the stakeholders."

(2) what are the features and characteristics of the technologies we would like to have that will replace the ways of the future?

(2) do the technologies exist, do existing technologies need be adapted in a minor or major way, or does new technology need to be developed?

(3) what sector or firm is in the best position to develop or deploy the desired technology?

(4) what governmental, corporate, labor and community-based policies need to be put into place to encourage the development or diffusion/transfer of the desired technology?

The answers to these questions depend on our definition of sustainability, the specific industry and the kinds of firms involved with the target problem, the technological properties of the target problem, the conceptual or behavioral model of how technological change takes place. But there is more to consider. Are we to design policies, short-term or long-term? Do we prefer an evolutionary or more radical response?

Do we believe in directive intervention (targeted) policies or policies that simply stimulate changes and create a nurturing environment for investment in environmental and technology innovation/diffusion without giving competitive advantages to one technology over another? Are we willing to provide a degree of "shock therapy" to the economy and encourage the emergence of new industries and technologies and the displacement of the old?

A number of academics and discussants expressed a variety of views and opinions related to these issues. Ben Dankbaar argued that a transition to sustainability will necessarily involve changes to the technological basis of a firm's activities. The shift towards technology (changed) involves much more than the management of R&D. It includes not only the incorporation of clean technologies into business experimentation. Problematic changes and changes in the firm's relations with different industrial actors. [Compare the earlier discussion on trans-organizational networks.] The management of technological change should be an enterprise-level activity. [Compare the earlier discussion of intra-organizational networks] Moreover, the activity should be explicit. The concept of sustainability is not enough; there is a need for a framework which is not entrepreneurial or corporate.

In fostering a transition to sustainability that focuses on technology, there are five essential questions to work through: 1. What do we already have that may work as substitutes for existing hardware and sustainability is more than pollution prevention:

1. what are the technologies of extraction, manufacturing, services, transportation, agriculture, energy, waste management etc. that present significant sustainability problems?

2. what are the features and characteristics of the technologies we would like to have that will replace the ways of the future?

3. do the technologies exist, do existing technologies need be adapted in a minor or major way, or does new technology need to be developed?

4. what sector or firm is in the best position to develop or deploy the desired technology?

5. what governmental, corporate, labor and community-based policies need to be put into place to encourage the development or diffusion/transfer of the desired technology?

The answers to these questions depend on our definition of sustainability, the specific industry and the kind of firms involved with the target problem, the technological properties of the target problem, the conceptual or behavioral model of how technological change takes place. But there is more to consider. Are we to design policies, short-term or long-term? Do we prefer an evolutionary or more radical response?
technologies as they do from the technologies they have always been investing in. Finally, John Elkington re-iterated a point made in his earlier presentation. It is not clear that it is always technology that will solve the source of the road to sustainability. Technological "fixes" have caused us problems in the past, so caution is advised.

In a workshop devoted to the transition to sustainable technologies, Alain Irwin explored the belief that there is no "natural trajectory" to sustainability independent of the actors. In their paper, Green, Irwin and McMeekin argue that firms require appropriate organizational structures and cultures to look for and create discontinuities and coordinate them with technological possibilities. They reported the results of a survey of 101 UK firms that had earlier expressed commitment to sustainability and was hence not representative of UK industry. Questions were asked about both product and process changes. Companies were prompted to design environmentally-friendly products by the pressures from existing regulations and anticipation of future regulation. In addition, companies were motivated by the prospect of increasing market share. For processes, companies were likewise driven by regulatory concerns, with the potential for cost savings acting as a strong motivator. The commitment of personnel was also seen as one of the strongest factors. Half of the product developments were the result of major technological changes and half resulted from modifications of existing technology (Incremental Innovation). In contrast, Precision Development was characterized as resulting in major technological change in 30% of the cases and in modifications of existing technology in 70%.

In their papers, Ken Green, Alan Irwin and Andrew McMeekin, and René Kemp emphasize the importance of shifts between different types of technology (also referred to as technological paradigms or guideposts) as opposed to shifts within a technological regime. A technological regime is a technology-specific trajectory involving design configurations, resource allocation and a development agenda. A parallel distinction is made between evolutionary change and radical or discontinuous change. Once established, a technological regime creates a "selection environment" that tends to expand learning inside and excludes excursions outside, at least as long as incremental improvements in technology are rewarded in the market. When there are increasing returns with adoption, at some point society may become locked into a suboptimal technological system. Established networks between firms, suppliers, customers and users may perpetuate a technology.

New (paradigm-breaking) scientific insights, the failure or expense of old approaches, or the presence of anticipated problems, reflecting technical, theoretical or economic limits and constraints; and risk-taking entrepreneurial activity contribute to initiating a shift between technological regimes. Unlike evolutionary changes which tend to preserve the players in established networks, radical shifts are likely to be disruptive and create new winners and losers. Since governments and influences are inevitably distinct by existing stakeholders and players, disruptive advances are resisted and dominant technologies remain entrenched.

The idea that government should be a trustee for, and therefore actively promote, new technology, industry, firms and resulting new networks is difficult to put into practice. When there is sufficient societal support for dramatic changes that existing technologies cannot deliver, government may be willing to place constraints on established technologies creating a market niche which may spur innovation. (Contrast the conflicting views of regulation on industry. New regulations are resisted by regulated firms, arguing "unproductive" diversion of financial and human resources, while new and competing entrants silently seize the opportunity to penetrate markets with products and processes that design the environmental, health and safety performance requirements into their technologies—viewing them as opportunities rather than constraints. Sometimes, of course, collaboration between traditional firms and firms with a different technological base occurs, or established firms merge with or buy up new firms. Witness the absorption of biotechnology firms by established chemical and pharmaceutical companies.)

Whether government is willing to directly aid and accelerate new development through R&D subsidies, support of needed infrastructure, tax instruments and procurement practices is another matter and requires that government think in terms of an industrial policy. Apart from government, sufficient (individual and industrial) consumer/customer demand and a critical mass of the entrepreneurs committed to the development of an environmental technology will engage in "strategic niche management." (Johan Schot, Remco Hoogma, and Rob van den Brink suggest that rather than wait for consumer demand to mature, government can accelerate that demand by experimenting with policies that encourage consumers to develop the market (the so-called Dutch disease) and provide feedback to developers to facilitate design changes and foster market acceptance reflecting evolving consumer tastes. Creating consumer pressure in this way is probably the most effective way in which government regulation can exert influence on the dynamics of the competing dominant technology.

At the end of the conference, Thomas Gladwin was invited to offer a reflection of the research goals of the Greening of Industry Network. He urged that the network move from greening to sustainability, incorporate biocentric and longer-term global considerations into the problems of pollution, public goods and services, and expand the focus of future research and conferences on workers and employment, SMEs, developing countries, distributional equity, social innovation and justice, Gladwin also encouraged the network to regularly review its own work and take stock of its goals of contributing to useful and policy-relevant research. Gladwin suggested that emphasis in the future be placed on trade and other policies as means of fostering self-reliance in the achievement of sustainability in developing countries and in countries with transition. Finally, educational initiatives targeted at all stakeholders to enable a transition to sustainability should receive more attention.

Whatever the concept of sustainability suggests to policy makers, ideology affects the choice of instruments or approaches for achieving it. Those preferring an evolutionary path to sustainability (we might call them evolutionists) may advocate changing attitudes by educating, informing and persuading decision makers in government and industry to undertake a transformation. If it can be shown that there are substantial economic or performance benefits associated with change, this might start them out on that empirically based research. Evolutionists believe that society is self-interested of institutions to change. Otherwise, appeals to do the right thing (arguing for a moral imperative to save the whales, for example) or preserving finite resources (arguing against hazardous waste disposal practices) may be the only way to get communities to act.

Economists are likely to be wedded to using prices (natural resources, the cost of waste disposal, environmental damage etc) as the mechanism for the bring about changes in corporate and societal behavior to improve the environment. Indeed, environmental pollution is defined as an economic problem by economists. Efficiently designed policies are necessary to effect the preferred outcomes, but economic means are assumed to be the best way to get there. For some economists, it appears that the means by which we encourage change may even be more important than the pathway or outcome. Alternatively expressed, correct pathways and outcomes are most likely to emerge only if the prices are right. Efficient policies may or may not be superior to pollution control. It depends on the net effect on social welfare.

There are those who prefer government intervention in the form of regulation, taxation, and mandated behavioral changes to encourage pollution prevention and sustainability. They cite the propensity of past [deficient] regulation to encourage strong end-of-pipe pollution control; market failure in terms of imperfect or unavailable information (like the future trajectory of global warming); economic monoply power; the failure of any pricing mechanism to value human life, diseases and suffering (and ecological disasters and loss of biological diversity) and environmental equity or Justice; limits to growth and time horizons disparities between recognizing an environmental problem and being able to do anything about it; and the inertia of current institutions to change. Advocates of regulation might be willing to use information tools, persuasion and economic instruments superimposed upon a regulatory system, but many economists avoid regulatory solutions in favor of economic instruments. Since they believe in utilitarian theory, values and attitudes are considered endogenous to the market, not something government ought to try to change. To the extent changes are need, they should be based on getting the prices right. Evolutionists might very well dislike both regulation and the market, arguing it is the fundamental values that must change. The research and price adjustments are not the best ways to change attitudes and values. They may even be considered to be inappropriate means.

Some advocates are primarily driven by desired outcomes, others by instrumentality. Against this background of ideological conflict, different perceptions of the state of the environment, varying notions of how both the industrial enterprise and stakeholders actually behave, and where we as a society actually want to be in a decade, two decades or more, we must begin to choose the means for a societal transformation. Some, but by no means all, of our uncertainties can be answered by doing research in critical areas.

The published work produced of the first Greening of Industry Network conference, Environmental Strategies for Industry: Greener Economic Growth, was an attempt to provide a better understanding of: (1) how a learning process can transform firms from defensive, end-of-pipe strategies for minimizing pollution, waste, and costs, to more sustainable and pro-active approaches to more innovative approaches that integrate concerns for the environment with the traditional concerns for output and profit, (2) how to incorporate technical and economic criteria for decision making for future strategic planning, (3) how to utilize government policies and interventions to bring about a transformation in the firm from a single-minded focus on profit to the adoption of a more innovative and integrated strategy, and (4) the roles of suppliers and customers in influencing private-sector behavior.

The complement with the structure used in this writing to describe the research papers and discussions in the second Greening of Industry Network conference, the following organizational principles were used: (1) to identify key company strategic issues or opportunities, (2) to describe in detail the research and conferences, including the upcoming third conference in Copenhagen in November 1994.

1. Concepts of the Sustainable Enterprise and the Sustainable Society

Further refinement and discussion of the dimensions of sustainability are needed. The concepts are necessarily evolving and they set the stage for specific research into the definition of national and international goals and the means of achieving them.

2. Networks for Advancing Sustainability

[through the management of, or influence on, both technological and managerial innovation and diffusion]
The examination of influential stakeholders within the concept of networks has proven to be particularly useful.

A. intra-organizational networks
   - examination of intra-firm dynamics involving employees concerned with the design of products and processes, the management of production technology, and marketing strategies

B. trans-organizational networks
   - involving business stakeholders (suppliers, contractors, customers/consumers)

C. industry-community networks
   - involving nonbusiness stakeholders concerned with the practices of the firm

D. industry-worker networks (industrial relations systems)
   - workers as "non-business" stakeholders
   - workers as sources of ideas
   - workers providing pressure for environmental management systems

E. community-worker networks
   - bringing pressure for environmental management systems via community channels.

3. Information Policies to enable and empower the private-sector stakeholders: A Help or a Hindrance?
   - LCA's: what do they leave out?
   - Environmental Audits: what do they leave out?
   - Right-to-know: does it include information about technology as well as risk?

4. Technology Transfer (Diffusion of technology) involving both the public and private sector
   - between firms within an industry (role of trade associations too)
   - between different industries
   - between countries
     i) developed-developed
     ii) developed-LDCs

5. Government's role in stimulating innovation in technology, work organization, and management (involving cleaner production, sustainable technology and sustainable employment)
   - government support for innovation
   - government regulation
   - economic instruments

6. Transformation to a Sustainable Society
   - consideration of policies, mechanisms, and strategies to bring about both evolutionary and radical transformations

This research menu or agenda is suggested as a format for both identifying future research needs and for organizing future conference discussions.
MONDAY, NOVEMBER 15

7:30am - 9:00am  Grand Ballroom Pre-Assembly West Tower

- Continental Breakfast

9:00am - 9:30am  Grand Ballroom A

Plenary Speaker 1: Arun Kumar

Introduction: Kurt Fischer, Center for Environmental Management, Tufts University, Medford, Massachusetts, U.S.A.
Speaker: Arun Kumar, Development Alternatives, New Delhi, India, Designing the Sustainable Enterprise - A Strategy for Sustainable Livelihoods

Plenary Panel:

Panelists:
   - Andrew Sors, Commission of the European Communities, Brussels, Belgium
   - Harris Glackman, University of Southern Maine, Portland, Maine, U.S.A.
   - Joan Bavaria, Coalition for Environmentally Responsible Economies, Boston, Massachusetts, U.S.A.
   - Grace Weaver, Council of Great Lakes Industries, Rochester, New York, U.S.A.
   - Arun Kumar, Development Alternatives

9:30am - 10:30am  Grand Ballroom A

10:30am - 11:00am

11:00am - 12:30pm  Grand Ballroom A

- Break

Concurrent Workshops:

- Dialogue Workshop I: Designing the Sustainable Enterprise - A Strategy for Sustainable Livelihoods
  Facilitator: Thomas Glackman, Stern School of Business, New York University, New York, New York, U.S.A.
  Panelists:
  - Abby Pinse, U.S. Environmental Protection Agency
  - Andrew Sors, Commission of the European Communities
  - Joan Bavaria, Coalition for Environmentally Responsible Economies
  - Harris Glackman, United Nations Centre on Transnational Corporations (formerly)
  - Grace Weaver, Council of Great Lakes Industries
  - Arun Kumar, Development Alternatives

11:00am - 12:30am (Cont.)  Skyline Suites

Research Workshop 2: Greening of Corporate Accounting

Chair: Judith Ugelow, The Aarhus School of Business, Aarhus, Denmark
Organizing Environmental Management in Small and Medium-Sized Firms, A Cost-Benefit Instrument as a Tool to Integrate Environmental Policy into the Overall Business-Policy, Anja de Groene and Job de Haan, Tilburg University, Tilburg, The Netherlands

Skyline Suites

Research Workshop 3: Greening of Learning

Chair: Klaas Visscher, National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands
The Limits and Possibilities in Designing the Environmentally Sustainable Firm, Susanne Ostlund, Stockholm School of Economics, Sweden
Towards Management of Environmentally Sensitive Technology: A Typology of Collaboration, Nigel Roome and Sarah Clarke, York University, Ontario, Canada
Environmental Considerations in Strategic Decision-making at a Large Corporation within the Chemical Industry, Frank Neumann and Jan-Geep Bouma, E@$clus Centre for Environmental Studies, Rotterdam, The Netherlands

Skyline Suites

Perspective Workshop I: Design for the Environment

Chair: Sybren de Ho, Netherlands Organization for Technology Assessment, The Hague, The Netherlands
Patricia Dillon, Center for Environmental Management, Tufts University, Medford, Massachusetts, U.S.A.
Han Brezet, Delft University of Technology, Delft, The Netherlands
Marcel Col, Aries Environmental Consultancy, Berg en Dal, The Netherlands
Werner Glansing, ATAT Bell Laboratories, Princeton, New Jersey, U.S.A.

12:30pm - 2:00pm  Grand Ballroom B

2:00pm - 2:30pm  Grand Ballroom A

- Luncheon

Plenary Speaker 2: Philip Vergragt

Introduction: Johan Schot, Centre for Studies of Science, Technology, and Society, University of Twente, Enschede, The Netherlands
Philip Vergragt, Delft University of Technology, Delft, The Netherlands, Back to the Future, or How to Develop Visions on Sustainable Technology

2:30pm - 3:00pm  Discussion
**Concurrent Workshops**

**DIALOGUE WORKSHOP II**

**Sustainability and Long-Term Planning By Firms**

**Facilitator:** Jacqueline Cramer, TNO Centre for Technology and Policy Studies, Apeldoorn, The Netherlands

**Panel Members:**
- Robert Petersen, Raytheon Environmental Services, Cambridge, Massachusetts, U.S.A.
- Ulrich Steger, Institute for Environmental Management and Business Administration, Gevelsberg-Werden, Germany
- Philip Vergragt, Delft University of Technology, Delft, The Netherlands
- Peter Bright, Shell International Petroleum, Company Ltd., London, England

**Skyline Suites**

**RESEARCH WORKSHOP 4**

**Sustainable Strategies II**

**Chair:** George Mitchell, Fletcher School of Law and Diplomacy, Tufts University, Medford, Massachusetts, U.S.A.


- Under Which Conditions do Transnational Aluminum Producers Contribute to a More Ecologically Sustainable Industrial Development, Audun Roulud, Centre for Development and the Environment, University of Oslo, Oslo, Norway

**Skyline Suites**

**RESEARCH WORKSHOP 5**

**Greening of Accounting II**

**Chair:** Johan Pien, Deloitte & Touche, Amsterdam, The Netherlands

- The Green Link: Cost Accounting and the Sustainable Enterprise, Allen L. White, Telus Institute, Boston, Massachusetts, U.S.A.

- The Greening of Capital Investment Decisions: A Petroleum Industry Case Study, Olof Zarring, Gothenburg Research Institute, Gothenburg, Sweden

**Skyline Suites**

**RESEARCH WORKSHOP 6**

**Greening of Learning in Networks II**

**Chair:** Hans Gabel, European Institute of Business Administration, INSEAD, Fontainebleau, France

- Becoming a 'Green' Company: The Importance of Culture in the Greening Process, John Ehrenfield, Sc.D., Director, Business and Environment Program, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A. and Andrew Hoffman, Department of Civil and Environmental Engineering, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.

**TUESDAY, NOVEMBER 16**

### Continental Breakfast

- **Plenary Speaker 3:** Ben Dankbaar
  - Introduction: Patricia Dillon, Center for Environmental Management, Tufts University, Medford, Massachusetts, U.S.A.
  - Speaker: Ben Dankbaar, The University of Limburg, Maastricht, The Netherlands, The Transition to Sustainability from the Perspective of Technology Management

### Break

### Concurrent Workshops

**Dialogue Workshop III:**

The Transition to Sustainability from the Perspective of Technology Management

- **Panel Chair:** William Cannell, Commission of the European Communities, Brussels, Belgium
- **Panel Members:**
  - Ben Dankbaar, University of Limburg, Maastricht, The Netherlands
  - Harry Schilling, General Electric Capital Corporation
  - Fred Moore, Union Carbide Corporation, Danbury, Connecticut, U.S.A.

**Perspective Workshop II:**

Pollution Prevention and Facility Planning

- **Facilitator:** Kenneth Geiser, The Massachusetts Tissue Use Reduction Institute (TURI), University of Massachusetts, Lowell, Massachusetts, U.S.A.
- **Panelists:**
  - Patrick Deines, E.A.R.S. and the Polaroïd Approach to Facility Planning, Division of Environmental Health and Safety, Polaroid Corporation, Waltham, Massachusetts, U.S.A.
  - Tim Hawes, Using Total Quality Environmental Management as a Management Framework for Pollution Prevention within a Plant Site or Firm, Council of Great Lakes Industries, Rochester, New York, U.S.A.
  - Grace Wever, Aalborg University, Research Group on Technology and Society, Aalborg, Denmark

### Designing The Sustainable Enterprise: Revisited I

- **Reception:**
  - **Welcome:** John DiBiagio, President, Tufts University, Medford, Massachusetts, U.S.A.
  - **Introduction and Remarks:** Melvin Bernstein, Vice President of Arts, Sciences and Technology, Tufts University, Medford, Massachusetts, U.S.A.

- **Keynote Speaker 2:** John Elkington
  - **Speaker:** John Elkington, SustainAbility, Ltd., London, England
  - **Win-Win-Win Business Strategies for Sustainable Development**
  - **Discussion Chair:** Matthew Arnold, Management Institute for Environment and Business, Washington, D.C., U.S.A.

- **Dinner**
From Risk Communication to Collaborative Decision-Making

Chair: Frances Lynn

Community Advisory Panels: Accidents and Current Operation within the Chemical Industry, Frances M. Lynn, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, U.S.A.

Improving Credibility with Communities: The Organization of Risk Communication Efforts at Two Chemical Plants, Caron Chess, Center for Environmental Communication, Cook College, Rutgers University, New Brunswick, New Jersey, U.S.A.

Communicating with the Public at the Local Level: The Role of Local Emergency Planning Committee (LEPCs) in Community Right-to-Know, Kathleen Rost, University of Massachusetts Medical Center, Worcester, Massachusetts, and Sheldon Keesey, Department of Urban and Environmental Policy, Tufts University, Medford, Massachusetts, U.S.A.

Commentator: Suzanne Georg, Institute for Transport, Tourism and Regional Economics, Copenhagen Business School, Copenhagen, Denmark

Measuring Sustainability

Chair: Kent Porne, Department of Political Science, Tufts University, Medford, Massachusetts, U.S.A.

Accounting for Sustainable Development, Boran Bergstrom, Svensk Företagsforskning AB, Stockholm, Sweden

Eco-Controlling – A Management Instrument for the Future, Hendrik Halloy, Institut für Betriebswirtschaftslehre, Universität Oldenburg, Oldenburg, Germany


Business Environmental Performance Management, Peter James, Ashridge Management College, Hertfordshire, England

Regulatory Dynamics:

Chair: Nicholas Ashford, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.

The Role of LCA in the Discussion about Environmental Impact of Packaging, Peter Groeneveld and Eric Jan Tuinga, Vrije Universiteit, Centrum Algemene Vorming, Amsterdam, The Netherlands

The Gaining of the EU Agrochemical Market: Regulation and Competition, Alain Nadal, CERNA, Ecole des Mines de Paris, Paris, France


Luncheon
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