Voluntary, Collaborative, and Information-Based Policies:
Lessons and Next Steps for Environmental and Energy Policy in the United States and Europe

Theo de Bruijn and Vicki Norberg-Bohm

Energy Technology Innovation Project
Belfer Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University

November 2001

CITATION INFORMATION

This paper may be cited as: Bruijn, Theo de and Vicki Norberg-Bohm, "Voluntary, Collaborative, and Information-Based Policies: Lessons and Next Steps for Environmental and Energy Policy in the United States and Europe," Energy Technology Innovation Project, Belfer Center for Science and International Affairs, and Regulatory Policy Program, Center for Business and Government, Kennedy School of Government, Harvard University, 2001. This paper is available at: http://ksgnotes1.harvard.edu/BCSIA/ETIP.nsf/www/Home and http://www.ksg.harvard.edu/cbg/rpphome.htm. Comments are welcome and may be directed to Vicki Norberg-Bohm at BCSIA, Kennedy School of Government, Harvard University, Cambridge, MA 02138; Email vicki_norberg-bohm@harvard.edu.

SPONSORING RESEARCH PROGRAMS

The Energy Technology Innovation Project (ETIP) at the Belfer Center for Science and International Affairs is a joint project of the Science and Technology Policy Program and the Energy and Natural Resources Program. Our focus is on crafting and catalyzing a set of policies and institutions that can stimulate the research, development, and deployment of energy technologies that can address the full range energy-related challenges of the 21st century, including environment, development and security issues. ETIP has ongoing research in two areas: (1) Energy Technology Policy for a Greenhouse-Gas Constrained World and (2) Technology Innovation Studies. In the first area, we are currently focused on the U.S., China, and India, with a strong emphasis on the role of international cooperation in the development and deployment of cleaner energy systems. In the second area, we examine how government policy and programs can play an effective role in stimulating private sector investments in the development and deployment of cleaner energy technologies.

The Regulatory Policy Program (RPP) at the Center for Business and Government develops and tests leading ideas on regulation and regulatory institutions. Our goal is to improve regulatory decision making across a range of policy realms. RPP's research aims to improve the global society and economy by understanding the impacts of regulation and creating better decisions about the design and implementation of regulatory strategies. RPP's efforts are organized around three areas: (1) Regulation, Markets, and Deregulation, (2) Alternative Regulatory Instruments, and (3) Regulatory Institutions. The first area addresses the conditions under which regulation achieves social value. The second area explores the effectiveness of alternative regulatory instruments such as information-based regulation and management-based regulation in achieving social goals. The third area addresses how regulatory institutions are working in practice, and how they can be better managed to promote the underlying values served by regulation while maintaining trust and legitimacy.

ACKNOWLEDGEMENTS

There are many people to thank for making this a successful workshop. First, we want to thank the authors of the papers for contributing their insights from years of research. Secondly, we want to thank the discussants for providing their insights from efforts to shape and implement these policy innovations. Thirdly, would like to thank all of the other participants who contributed to a lively discussion. We are grateful to the Department of Energy for their financial support for this workshop, and to The Netherlands Organization for Scientific Research (NWO), which supported the writing of this report with a travel scholarship. We also want to thank the research centers that supported our efforts to organize this workshop: the Science Technology and Public Policy Program at the Belfer Center for Science and International Affairs and the Regulatory Policy Program at the Center for Business and Government, both at Harvard University, and the Center for Clean Technology and Environmental Policy at the University of Twente. We would never have been able to create this workshop report without the diligent and thorough efforts of Chad White and William Nickerson in recording the conversation at the workshop. Finally, Peter Sedlak provided superb administrative assistance in all of the logistical aspects of the workshop.

While we have tried to faithfully capture the key ideas of this workshop, the authors take responsibility for any omissions or errors. The views expressed within this paper are the authors' and do not necessarily reflect those of workshop sponsors.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ..... **i**

TABLE OF CONTENTS ..... **iii**

EXECUTIVE SUMMARY ..... **v**

INTRODUCTION **1**

VOLUNTARY PROGRAMS **2**

INDUSTRY SECTOR COLLABORATION **6**

COLLABORATIVE APPROACHES FOR TECHNOLOGY DEVELOPMENT **9**

INFORMATION DISCLOSURE **13**

ENVIRONMENTAL MANAGEMENT SYSTEMS **18**

CONCLUSIONS **22**

CHARACTERISTICS OF THE NEW ENVIRONMENTAL AND ENERGY POLICY MECHANISMS: VOLUNTARY ACTION, COLLABORATION, AND INFORMATION STRATEGIES 23

EFFECTIVENESS: CROSSCUTTING ISSUES 25

THE PROSPECTS FOR VOLUNTARY, COLLABORATIVE, AND INFORMATION STRATEGIES 27

APPENDIX A: WORKSHOP ORGANIZERS **29**

APPENDIX B: WORKSHOP AGENDA **30**

APPENDIX C: PAPER ABSTRACTS **33**

APPENDIX D: PARTICIPANT BIOGRAPHY LIST **48**

EXECUTIVE SUMMARY

Over the past decade, the United States and many European countries have developed new approaches to environmental policy that are voluntary, collaborative, and information-based. These programs are attempts to engage industry in significant environmental improvements through dialogue, consensus-building, and voluntary action rather than the imperatives of direct regulation or the incentives of market-based approaches. This workshop examined the effectiveness of these innovative policies, focusing particularly on how these approaches can provide opportunities and incentives for private-sector leadership in environmental protection, and whether they can be effective in stimulating beyond compliance behavior and the development and diffusion of environmentally superior technologies. The workshop was organized into five panels: voluntary approaches, industry sector collaboration, collaborative approaches for technology development, information disclosure policy, and environmental management systems.

Taken as a whole, the programs examined in this workshop demonstrate more success than failure. Many of these programs have already improved the environment, as well as establishing long-term goals that hold up the prospect for more fundamental change in the future. However, when measured against the high standards for evaluation put forth in this workshop - industry leadership and the radical technological innovation - our evaluation is more circumspect. While the programs have contributed to technology innovation, it was more often incremental than radical. While there is evidence of private sector leadership, there is concern that it may be one-off rather than on going, and focused on near-term opportunities rather than longer-term and more difficult targets.

The overarching conclusion of the workshop is that voluntary, collaborative, and information programs can play a useful role in a comprehensive environmental strategy but only if they are carefully designed to fit with and complement the other elements of a nation's environmental policy system. Voluntary, collaborative, and information strategies can create capacity, transparency, and flexibility; facilitate the development of long-term agendas; provide opportunities and incentives for firms to assume leadership in environmental protection; and provide avenues for greater community and NGO participation. As demonstrated by the cases in this workshop, these new approaches can be effectively targeted toward capacity building or toward actual improvements in environmental performance. They can also be targeted toward either individual firms, in an effort to create leaders, or toward an entire industry sector, in an effort to bring forward all firms. Regardless of goals, there will remain a role for direct regulations and market-based approaches as part of an overall strategy - they will be needed to create sufficient pressures to push industry along the path toward sustainability. In the end, the real question therefore is not whether the new approaches should be used, but rather *how* they should be used.

Below, we first examine several conclusions that cut across the full range of programs, and then present lessons for each of the five types of programs.

Cross-cutting Themes

Integration with the Environmental Policy System
These new approaches are most effective when integrated with other policies and programs for three reasons:

- *Incentives external to the programs.* The imperative for change is often external to the programs, thus programs will be most effective when used synergistically with or as a complement to other policy approaches, particularly policy approaches that can provide incentives or imperatives to action.
- *Different approaches for leaders and laggards.* Voluntary, collaborative, and information-based approaches will be most effective in a dynamic system of regulation, in which the level of regulation is established by best practices at leading firms, and laggards are then brought forward by regulatory requirements. Voluntary, collaborative, and information-based approaches may be most appealing to pro-active firms and sectors while regulatory programs can force free-riders to comply.
- *Fundamental change in the dominant regulatory system.* These new approaches are most often a small innovation to the larger policy system. Thus, notwithstanding the potential advantages of voluntary, collaborative, and information-based approaches, they cannot be effective unless designed to work synergistically with the larger policy system. In some cases this will require legislative changes; in others a carefully design package of programs and policies that can build capability and provide incentives for action.

Transaction costs
High transaction costs is a critique that was aimed at nearly all of the programs examined in this workshop, and for these approaches more generally.

- Transaction costs should be considered when deciding whether to implement voluntary, collaborative, and information-based programs.
- Transaction costs should be evaluated against benefits of the program and compared to the transaction costs of alternative approaches for reaching environmental goals.

Evaluation
Inadequate attention has been given to evaluation. Evaluation should be an integral part of program design, including collecting the necessary data and putting the funding for evaluation into the budget of new programs.

- Although information gathered through post-program interviewing and surveys can be useful, efforts should be made to gather real-time data on program outcomes.
- It is essential to look beyond process variables (e.g. number of participants) and evaluate actions taken to reduce environmental impacts as well as the actual reduction of environmental impacts.

Voluntary Approaches

Three programs were presented in this session: U.S. Energy Star (by Bruce Paton), the Dutch Policy Program on Environmental Management (by Theo de Bruijn and Kris Lulofs) and U.S. Project XL (by Alfred Marcus, Donald Geffen and Ken Sexton). The commentators for this session were Jerry Dion, Tim Jenkins, Shelley Metzenbaum, and Leslie Carothers.

- *Win-win opportunities*. Voluntary programs can be effective in stimulating firms to take win-win actions that the firms would not have identified without the intervention of a voluntary program.

- *Tie to incentives and imperatives for action*. From the standpoint of more fundamental industrial transformation and technological innovation, voluntary programs will be most effective if they are tied to incentives or imperatives for action. These can be either integral to the voluntary approach or through policies external to the voluntary approach.
  - Internal incentives include: a credible threat of regulation if voluntary action is not taken, cost-sharing, and public recognition.
  - External incentives include: regulations, procurement policies, and other economic incentives.

- *Fit with the national policy style.* The existing regulatory culture needs to be considered when assessing the potential goals and benefits of voluntary approaches. The importance of interaction between voluntary approaches and the rest of the environmental policy system suggests that coherence and fit with the policy style is important.

- *Implementation through networks.* Voluntary programs may be most successful if they are implemented through existing networks or institutions that have compatible objectives and capabilities.

Industry Sector Approaches

Three programs were presented in this session: U.S. Common Sense Initiative (by Laurie Allen and Cary Coglianese), The Dutch Target Group Policy (by Peter Hofman and Geerten Schrama) and the German End-of-Life Vehicles Program (by Helge Jörgens and Per-Olof Busch). The commentators for this session were Marilyn Brown, Daryl Banks and Dan Fiorino.

- *Conditions for effective industry sector collaboration:* Industry sector approaches are likely to be most effective under the following conditions:
  - Clear goals that are externally-imposed or externally-mediated.
  - Compatible and embedded in the larger national and environmental regulatory system.
  - "Voluntary but not without obligations", in other words there is an alternative to the collaborative process for reaching publicly established environmental goals.
  - A well-organized and homogenous sector with a strong representative body (e.g. the trade association) or a small and orderly sector consisting of only a few companies.

- *Long-term commitments*. Industry sector approaches have been successful in obtaining commitments from the private sector for long-term goals that will substantially improve environmental performance and will require radical technological innovation.
  - It is not clear that the programs provide adequate incentives or enforcement mechanisms for these long-term goals.
  - The programs should implement mid-term requirements to demonstrate private sector actions toward meeting long-term goals.

- *Long-term commitments vs. flexibility:* In many of these programs, the private sector has made long-term commitments in exchange for promises that no new requirements would be imposed.
  - These long-term agreements reduce societies ability to respond to new environmental hazards, or to new understandings of current environmental hazards.
  - New mechanisms are needed to address this concern.

Collaborative Approaches for Technology Development

Two papers were presented in this session: R&D collaboration in the Power Sector in the United States (by Vicki Norberg-Bohm and Robert Margolis), and Danish Cleaner Technology Programs (by Ulrik Jørgensen). The commentators for the session were Jerry Rogers and Nils Thorsen.

- *Effective for near-and mid-range technology development.* Collaborative technology programs are potentially powerful instruments to reach near-and mid-range technology development goals.

- *Networks of technological capability*. Collaborative technology programs can provide opportunities and incentives for manufacturers, suppliers, universities, national laboratories, and consultants to work together to reduce risks.

- *Design elements*: Collaborative technology programs are most effective if they:
  - Set challenging goals that require collaboration
  - Provide funding and require organizational structures that increase collaboration amongst firms and other actors with technological capabilities
  - Link the R&D function with the business organization.

- *Shifting environmental goals*: Over the time frame of technology development (often a decade or more), our knowledge about environmental impacts will increase and may result in the need for more stringent environmental goals. Technology programs should be designed with this possibility in mind by including the participation of a broad range of stakeholders and periodic evaluation of technology targets.

- *Market creation*. Cleaner technology programs need to be commercially viable. In many cases this will require simultaneous use of other policies and regulatory programs that create markets for the emerging cleaner technologies.

Information Disclosure

Two programs were presented in this session: the U.S. Toxic Release Inventory (by Mary Graham and Kathryn Miller), and the Norwegian Accounting Act of 1998 (by Audun Ruud). The commentators for this session were Robert Massie, Mark Greenwood and Rolf Marstrander.

- *Internal and external pressure*. Mandatory public disclosure systems are effective by producing external pressures on firms and by changing internal decision-making.
  - *External pressures*: Negative recognition can motivate short-term efforts to quickly reduce emissions, and the accompanying negative publicity.
    - Further research is needed to establish whether negative recognition can stimulate long-term and pollution prevention approaches. Requirements for a life-cycle perspective, reporting of future plans, and approval by the board-of-directors (as required by the Norwegian accounting act), represent new efforts in this direction.
  - *Internal pressures*: New information generated inside firms can build capacity for improving environmental performance.
    - Information disclosure policies will be a stronger impetus for change if they require firms to develop information that is useful internally.
- *Support for other policies*. Information disclosure can by used to support other environmental policy and programs.
  - Information disclosure can be used for priority setting in both public and private sectors.
  - Information disclosure can provide an underpinning for voluntary policies and programs.

- *Design criteria*. Effective information disclosure policy must be designed for legitimacy, accuracy, consistency, comprehensiveness and utility.
  - The effectiveness of information disclosure policy depends not only these characteristics, but also on the mobilization of a set of stakeholders that can use data to support decision-making and press for change.

  - *Private market for information*. There is a strong and growing private sector market for information disclosure both as advocates for information disclosure and as users of this information. Thus, government is not the only the powerful driver of information disclosure.

Environmental Management Systems (EMS)

Two programs were presented in this session: the U.S. StarTrack program (by Jennifer Nash) and the European Eco-Management and Audit Scheme (by Andrew Gouldson). The commentators for this session were John Harris, Martin Baxter and Dan Fiorino.

- *EMS can be effective in:*
  - Increasing capacity for environmental improvement
  - Increasing awareness of the need for innovation for the environment
  - Identification of "win-win" opportunities for environmental improvement
  - Better compliance with environmental regulation.

- *EMS and drivers for change.* Although the adoption of an EMS raises the awareness of the need to innovate and help develop capacities for technological change, external incentives or imperatives for change are needed for the actual utilization of these capacities.

- *Government-sponsored EMS.*

  - Characteristics identified as contributing to the effectiveness of government-sponsored EMS include:
    - Third party verification
    - Comprehensive and regular public reporting
    - Requirements for future planning for continued environmental improvement, including progress toward specific environmental goals.

  - The current approaches to EMS are overly bureaucratic. Efforts should be made to reduce transaction costs by focusing on information generation that is useful to the firm and streamlining reporting requirements.

    - EMS may have strong influence only when first adopted, with benefits decreasing overtime as the system becomes institutionalized. Government sponsored EMS should work to crate incentives for continuous improvement.

  - *EMS and tiered environmental systems*. Adoption of EMS is not a sufficient criterion for establishing superior environmental performance, and thus not an adequate criterion for entry of firms into tiered systems of environmental regulation.

INTRODUCTION

On May 10-12, 2001, the Kennedy School of Government at Harvard University hosted a workshop entitled "Voluntary, Collaborative, and Information-Based Policies: Lessons and Next Steps for Environmental and Energy Policy in the United States and Europe." We now have over a decade of experimentation with these new policy approaches. It is thus timely to take stock of their effectiveness and make recommendations for future practice. This workshop focused particularly on how these approaches can provide opportunities and incentives for private-sector leadership in environmental protection, and whether they can be effective in stimulating beyond compliance behavior and the development and diffusion of environmentally superior technologies.

While the United States and many European countries are undertaking a number of experiments in Voluntary, Collaborative, and Information-Based policy, the specific ways in which these are designed and implemented differ considerably. In this workshop, we began to map, compare and explain the differences and similarities on both sides of the Atlantic. This provided a rich range of experience from which to draw lessons for future policy design. As these approaches are not being undertaken in isolation, one theme throughout the workshop was to examine how these approaches are effective individually, and when and how they can be effective when combined with standards and market-based approaches.

The workshop was organized by the Belfer Center for Science and International Affairs and the Center for Business and Government at the John F. Kennedy School of Government, Harvard University in partnership with the Center for Clean Technology and Environmental Policy at the University of Twente, the Netherlands (See Appendix A). The workshop was sponsored by the Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy.

The workshop brought together scholars and senior practitioners from government, industry, and the NGO community in the United States and Europe to examine the effectiveness of this set of innovative policy mechanisms. The workshop built on a book project that engaged scholars who have been doing in-depth studies of these innovative policy mechanisms. The practitioners in attendance brought a wide-range of experience in designing, implementing and evaluating these policy innovations.

The workshop was organized into five panels: voluntary approaches, industry sector collaboration, collaborative approaches for technology development, information disclosure policy, and environmental management systems. Each panel had two or three presentations on specific policies or programs, followed by a panel of three or four discussants. This was followed by an open discussion. The workshop agenda is provided in Appendix B. Abstracts for each of the papers is provided in Appendix C. Appendix D includes a list of workshop participants.

This report is organized with a section on each of the five panels. Each section summarizes the presentations and the subsequent discussion. The report aims to capture

the key lessons for future policy design. The workshop did not aim at consensus, and thus the report does not do so either. Rather, it presents the multiple perspectives represented at the workshop. It concludes with a section on crosscutting issues.

VOLUNTARY PROGRAMS

The papers presented on this panel represent a diverse set of voluntary programs, although they do not exhaust the many perturbations in voluntary approaches. The workshop focused particularly on voluntary programs that were oriented toward industrial transformation. Three programs were presented in this session: Energy Star (by Bruce Paton), the Dutch Policy Program on Environmental Management (by Theo de Bruijn and Kris Lulofs) and Project XL (by Alfred Marcus, Donald Geffen and Ken Sexton). Each of these programs focuses on encouraging individual firms to take action, but they have different types of targets and different approaches to organizing the participation of stakeholders. The commentators for this session were Jerry Dion, Tim Jenkins, Shelley Metzenbaum, and Leslie Carothers.

The first paper on the panel focused on Energy Star, a voluntary program aimed at energy-efficiency improvements in products such as computers and washing machines. Energy Star engages industry in negotiated agreements on the level of energy efficiency necessary to gain the use of the Energy Star label, while simultaneously working with the government and large companies to specify Energy STAR products in their procurement policies. Paton distinguishes between two mechanisms in voluntary programs: (1) converging mechanisms, which focus on changing the behavior of an entire industry simultaneously, and (2) separating mechanisms, which create best practices in leading firms. Separating mechanisms can eventually lead to convergence, as laggards come forward for competitive reasons or through subsequent regulation. The paper examines two of the Energy STAR product-labeling programs—Office Products and Washing Machines. These examples illustrate the differences in design and outcomes between converging and separating mechanisms. Paton concludes that both programs have led to significant energy savings, but through different routes.

The second paper on the panel examined the voluntary policy program on environmental management systems (EMS) in the Netherlands. The objective of this program was to have companies introduce an EMS by 1995. Although the ultimate goal of the program was to improve the environmental performance of companies, its main objectives were to generate mutual trust for government-industry collaboration, to enhance capacity building within industry, and to involve third parties in promoting environmental protection. Instead of dealing with SMEs directly, the Dutch government facilitated the formation of networks in which intermediary organizations acted as agents for change. De Bruijn and Lulofs report that this program design proved quite effective. Other factors leading to success in this program included the way in which it was embedded in the wider policy approach of the Netherlands, the fit with the general mediating policy style of the Netherlands, and the high level of public concern over environmental matters during the early 1990s.

The third paper examined Project XL, a facility-based program aimed at developing bold alternatives to the current approach to standard setting, permitting, implementation and enforcement. Under Project XL, industry and government agencies can petition for regulatory flexibility at a specific facility in exchange for producing an overall increase in environmental quality. Project XL was organized as a stakeholder process that required the participation not only of government and private firms, but also community groups. Marcus, et al. examined four cases in which firms tried to negotiate XL agreements, three of which succeeded. In general, Project XL resulted in far fewer agreements than had been expected by the EPA. The paper examines both the substantive and process issues that created barriers to negotiating Project XL agreements. A central goal of Project XL was to get superior environmental performance. However, it proved very hard to define this concept in practice. In terms of process, the paper identified the issue of lack of legal authority for changes in permitting practice, and examined how negotiating strategies affected the ability to finalize an agreement.

This panel did not include a paper examining voluntary programs that are mainly oriented toward the diffusion of technology. There are a number of programs of this type in the United States (for example Green Lights), which encourage firms and individuals to adopt technologies that are both cost competitive and environmentally enhancing. In other words, these programs focus on the "win-win opportunities." As such, they can be an effective part of environmental policy, particularly in reaching firms that are not adequately covered by current regulation or enforcement, and managing environmental issues for which there are not regulations. Nonetheless, these diffusion-oriented programs are not likely to be as influential in promoting longer-term industrial transformation as the types of programs we examined on this panel.

From the viewpoint of our authors and the practitioner participants, the Energy Star and Dutch EMS programs were judged as relative successes, while Project XL was judged a relative failure. Through the discussion, several lessons and issues were raised about effectiveness, including the interaction of voluntary approaches with other policy mechanisms, stakeholder participation, transaction costs, and a pressing need for evaluation.

Voluntary programs are likely to be most effective when used synergistically with or as a complement to other policy approaches, particularly policy approaches that can provide incentives (or disincentives) to action. One oft-cited example of this is the provision of a credible threat of regulation if parties do not reach a voluntary agreement. However, a threat of traditional "command and control" approaches is not the only complementary mechanism available to governments. Federal procurement policy provided a strong incentive in the case of Energy Star Office Products. For Energy Star Washing Machines, the voluntary labeling program and the government-mandated appliance standards worked synergistically to significantly improve efficiency, first for the top tier, and in the future for the majority of washing machines. In the case of voluntary adoption of EMS in the Netherlands, the incentive for firms was that it would provide them with the capabilities needed to reach the increasingly challenging goals in established by Dutch environmental policy. This interaction between regulation and these innovative

approaches will be taken up again in the next section on Industrial Sector Policies.

This session provided the beginning of a discussion that threaded throughout the workshop on finding a balance between "carrots, sticks, and sermons," in other words, how to design policy to provide an effective package of incentives, penalties and moral suasion. Voluntary programs, by nature, rely on carrots and sermons. The carrots that they can employ include information, recognition and/or regulatory relief or flexibility (although flexibility was difficult to implement in the case of Project XL). The workshop papers and discussion suggest that information and recognition alone will not encourage firms to make bold movements toward industrial transformation, although they can encourage some action. Thus voluntary programs had to provide additional benefits, such as regulatory flexibility or combine the benefits in voluntary programs with incentives (or disincentives) from other policies.

For voluntary programs aimed at technology innovation, tax incentives, R&D incentives, and avoidance of perceived regulatory threats may bring industry to the table, commercial opportunities will be necessary to keep them there. In other words, for firms to invest in new technologies there has to be a market for these technologies. Similarly, the consumers of these products must find them to be a better product on all fronts, and not simply more energy efficient or better for the environment. This is because, at least in the U.S., it has been very difficult to identify a large consumer-driven green market. Thus, the economics for new products and processes must work out without dependence on a premium for a green product.

The importance of interaction between voluntary approaches and the rest of the environmental policy system suggests that coherence and fit with the policy style is important, as demonstrated by the EMS program in the Netherlands. Furthermore, the existing regulatory culture needs to be considered when assessing the potential goals and benefits of voluntary approaches. For example, the UK regulatory culture is already quite flexible, so voluntary programs should focus on other approaches for improving environmental behavior. In the U.S., the ability to offer flexibility is limited by the regulatory structure and by those inside and outside EPA who believe greater flexibility will lead to the weakening of a system that has been effective in many respects.

The second issue examined in this panel was stakeholder participation. Voluntary programs require stakeholder participation to be politically viable. This panel raised a number of interesting lessons and issues related to stakeholder participation, including discussions of building network capabilities, clarity about agency roles, and high transaction costs. The Dutch EMS case was designed to build network capabilities. It drew on existing networks as well as created new institutions to act as nodes in the network. The evaluation suggests that some of the existing nodes were quite effective in implementing the program while new nodes were not. This suggests that programs may be most successful if they are implemented through existing institutions that have compatible objectives and capabilities.

Because they involved numerous stakeholders, the transaction costs of developing voluntary agreements can be quite high. Environmental agencies need to develop clear policies about stakeholder participation, including clarity about the role of the different levels of environmental protection agencies (federal, regional and state) and decision rules. Due to the high transaction costs, firms and NGOs will be reluctant to participate if they do not have a clear sense of who has authority to negotiate and to grant flexibility.

The high transaction costs also raise questions about the wisdom of pursuing facility-based voluntary approaches as a cornerstone of environmental policy reform. Nonetheless, truly innovative facility-based experiments may provide value by identifying areas where current policy can be improved. Perhaps more important for the subject of industrial transformation is that facility-based experiments may provide incentives and opportunities for firms to act as first movers. Successful technological innovation by first movers can later be used to set new performance standards for an entire industry.

The third issue we discussed was evaluation. In order to learn from our experimentation, these new voluntary approaches should be designed with a plan for evaluation. Evaluation can be challenging, as we often need to answer the "what if" question, i.e. try to compare results from the new policy with what would have happened without it. Nonetheless, this type of analysis is critical if we want to learn through experimentation. Thus, more attention should be given to evaluation, including making evaluation an integral part of program design, collecting the necessary data, and putting the funding for evaluation into the budget of new programs. For some of these programs, evaluation will require in-depth interviewing and surveys, but efforts should be made to gather information that could be used separately from what would be reported in hindsight from the participants.

At this point, we often have process-oriented data for evaluation, when what we really need is to evaluate the impact on the environment. Some voluntary programs, such as the Dutch EMS, are aimed at changing management structures; i.e. they have process goals. Even for these, it is essential to look beyond process variables (i.e. how many firms adopted EMS) and evaluate actions taken to reduce environmental impacts as well as the actual reduction of environmental impacts.

Throughout our discussion, in this session and those that followed, there was an effort to clarify the definition of terms such as voluntary, self-regulation, and co-regulation. The use of specific terms creates expectations to participating parties about the nature of the process that they are entering. Clearly, shared language and concepts would contribute to more effective program design and implementation. This issue was raised but not answered by the workshop, and we begin to take up this challenge in the conclusion.

Overall, these papers point to the considerable diversity in voluntary programs. These diverse programs suggest that voluntary programs can be effective in stimulating firms to take "win-win" actions that the firms would not have identified without the intervention of a voluntary program. However, from the standpoint of more fundamental industrial

transformation, voluntary programs are likely to be most effective when combined with other approaches, as the programs in and of themselves often do not provide sufficient incentives for substantially improved environmental performance or technology innovation. The interaction between the voluntary programs and the rest of the environmental policy system is thus crucial, and must include a fit with the existing national policy style. Remaining concerns include the often-high transaction costs and the lack of data for evaluating effectiveness.

INDUSTRY SECTOR COLLABORATION

The session on Industry Sector Collaboration focused on programs and policies that engaged industry sectors rather than individual firms. All of the programs put forward were as alternatives to the established command-and-control systems, each having the goal of overcoming the limitations of direct regulations in moving toward sustainability. The basic rationale was that a collaborative, consensus-based approach would result in more effective and efficient solutions for achieving challenging long-term environmental goals. In each country, governments expressed high expectations for the industry sector approaches. The first paper, by Laurie Allen and Cary Coglianese, examined the U.S. Common Sense Initiative. The second two papers were European cases: The Dutch Target Group Policy by Peter Hofman and Geerten Schrama and the German End-of-Life-Vehicles Program by Helge Jörgens and Per-Olof Busch. The commentators for this session were Marilyn Brown, Daryl Banks and Dan Fiorino.

The Common Sense Initiative (CSI) is the prominent example in the United States of a sector-based, collaborative approach to environmental policy. Its goals were to develop "cleaner, better, cheaper" solutions to environmental performance by fine-tuning environmental regulation to the specific circumstances of different industrial sectors. Under CSI, six subcommittees (one for each sector) composed of representatives from industry, NGOs, labor unions, and governments were convened and given the charge to make recommendations to an overarching Council. Allen and Coglianese conclude that CSI resulted in “nothing dramatic.” Due to its reliance on consensus-based decision making, its strictly voluntary nature, and the lack of legal authority to make changes to existing regulations, the limited number of agreements that were reached tended to shift towards the lowest common denominator of the players involved, focusing more on the goal of making environmental regulation more efficient, rather than the goal of increasing environmental protection.

The second paper in the session discussed the Dutch Target Group Policy. This policy is the central element in the current Dutch system of industrial environmental regulation. Instead of setting technology-forcing standards unilaterally the approach builds on close collaboration with industry. Through negotiations between sectors of industry, the Ministry of the Environment, and regional and local governments, agreements are sought concerning the contribution of specific industrial sectors to the goals laid out in the National Environmental Policy Plan. While some of the agreements are quite demanding, sectors may opt-out if technology does not develop at a pace that enables them to reach the agreed upon goals. The effectiveness of the target group policy so far

seems quite satisfactory, as interim goals have been met in most sectors. However, thus far the policy seems to promote mainly innovations of an incremental nature and wider adoption of best available technologies (BAT). It remains to be seen whether the R&D components of this approach along with private sector technology investments will result in the fundamental technology innovation and diffusion necessary to meet the program's longer-range targets for deep emission reductions. Another limitation of the policy is that it focuses on existing industries and technologies, so newcomers or new radically different technologies are not part of the negotiating process.

The third paper introduced the German End-of-life-vehicles Program. This program consists of a voluntary agreement between 16 branch organizations in the automotive, recycling and supply sector. Although voluntary, the agreement was reached under the threat of regulation. In response to the voluntary agreement, the German government refrained from a comprehensive regulation and instead introduced an ordinance to facilitate the implementation of the agreement. The agreement focuses on the design of cars and their components, as well as environmentally sound recycling and disposal of end-of-life vehicles. The agreement gives great leeway to automobile producers while it introduces rather strict, detailed and costly regulations for dismantlers and return stations. This result is due to the greater political power of the oligopolistic automobile industry as compared to the heterogeneous and weakly organized dismantling sector. Thus, while the sector-wide agreement has proven to be effective for short-term and urgent problems (toxic waste from car dismantling), Jörgens and Busch raise questions about the effectiveness for the longer-term issue of car recycling and the associated reduction of landfill waste. While the automobile companies have made a commitment to significant increases in the recyclability of cars by the year 2015, the agreement does not contain interim goals or requirements.

The discussion focused on the similarities and differences amongst the programs, including an examination of the differences in the approach to industry sector policies in the United States and Europe. Other key themes examined in this session included: use of consensus-based decision-making, the ability of these approaches to stimulate radical technological changes, and the tension between long-term commitments and flexibility.

There were three key differences between the U.S. and European programs. First, the U.S. program was completely voluntary, while the European programs were part of legislation that provided more traditional command-and-control as a back up if satisfactory voluntary agreements were not reached. Second, the collaborative approach was employed at different stages in the policy-making process. In the United States, the negotiations and consensus-based decision process was used for goal setting as well as implementing goals. In the Dutch program, the environmental ministry set goals and collaboration was used for implementation. The German program was somewhat in between these two models, as the industry had the ability to propose specific targets and timetables, but the environmental ministry had the authority to reject unsatisfactory proposals and move to more traditional regulation if necessary. A third difference is that the European programs were part of a more comprehensive and fundamental change in

environmental policy, while the U.S. program was an isolated experiment with no legislative authority to change the existing approach to environmental regulation. These three cases suggest that the European approach, which was "voluntary but not without obligations," focused on implementation rather than goal setting, and was integrated into a more fundamental change in environmental regulation, was much more effective than the U.S. approach. The argument that environmental consensus-based approaches can bring industry forward to take leadership on charting a path to sustainability simply did not hold up in these cases. Rather, we see the need for publicly established environmental goals, and private sector participation in determining how to meet those goals.

There was considerable discussion about whether consensus-building approaches are applicable in the United States, given the U.S. regulatory culture. The Netherlands, and to a lesser extent Germany, has strong corporatist trends. Consultation and collaboration might flourish better in this context than in the more adversarial system of the United States. Several participants suggested that an important lesson to take from the experience with CSI and other recent regulatory experiments is to adopt advisory processes, rather than consensus-based decision-making. One of the difficulties with the consensus process was a lack of clarity about who should be considered a "stakeholder." In practice, recalcitrant participants with no interest in an agreement held the process captive. The combination of voluntary participation and consensus-based decision-making was particularly ineffective.

The second set of questions focused on the relation between the collaborative sector-based approaches and innovation. Beyond the difficulties of CSI, participants raised questions about the ability of consensus-building approaches to lead to profound changes, even within the Dutch and German context. Thus far, these programs have succeeded in stimulating incremental innovation, and obtaining commitments from industry sectors for longer-term goals that will require radical technological innovation. The authors and participants alike questioned whether the programs provided adequate incentives and enforcement for the long-range goals. Related to this is the fact that in these cases, negotiations and consultation tended to end up in prescriptive lists of best available techniques (BAT). How is BAT going to help industry move beyond compliance? How can we overcome the problem that BAT tends to be a reflection of the state-of-the-art rather than breakthrough technology? This points to an ongoing tension in environmental policy between the desire to use performance targets and the need of both firms and the public to be certain that the technological approach used to meet performance targets is valid. Can we imagine a resolution of this need for certainty and verification without turning to a BAT scheme that creates technological lock-in rather than incentives for technological innovation? A final concern with regard to radical innovation is the fact that these programs focus on existing industries and technologies and therefore may have a lock-in effect. Some problems may be out of reach for a specific sector of industry or may best be solved by new entrants. The German program, which takes a value-chain approach, demonstrates both the potential and difficulties in expanding the participants in industry-sector collaborative programs.

A third line of discussion concerned the long-term characteristics of the programs versus the need for flexibility. Sustainable development is a very complex issue still surrounded by considerable uncertainty. Future insights into the cause and nature of environmental degradation will lead to a need for new policy developments. At the same time there is a clear need to develop long-term strategies in order to evoke profound changes. Sector-based approaches seem especially suitable for developing these long-term perspectives since they offer the possibility to deal with free-riders. Long-term agreements are also one of the attractive features for industry. As industry partners with government and other stakeholders in setting ambitious environmental goals, firms are looking in turn for some assurances that these goals will not change in mid-stream. While this is understandable and perhaps even necessary from the standpoint of establishing cooperative agreements with aggressive agendas, is it desirable? What kind of guarantees can and should be given about future regulatory requirements? How do we deal with evolving knowledge about environmental hazards? The tension between long-term planning and flexibility is a potential deadlock for consensus-based and sector-based approaches that still needs to be addressed.

In sum, the sector-based approaches were launched with high expectations for overcoming the limitations of direct regulation and leading toward substantial long-range improvements in environmental performance. This session raised questions about whether the sector-based approaches would be able to live up to these expectations. It suggested that these approaches need to have clear externally-imposed or externally-mediated goals, that they are most effective in policy implementation, and that they must be compatible with and embedded in the larger national environmental regulatory system. While it is too soon to judge their long-term influence, many participants raised concerns about the lack of meaningful mid-term requirements that would demonstrate private sector actions toward meeting long-range goals. Given that these programs often involve long-term negotiated agreements between government and industry, there was also concern about maintaining the flexibility to respond to new environmental hazards or new information on existing environmental hazards.

COLLABORATIVE APPROACHES FOR TECHNOLOGY DEVELOPMENT

The programs evaluated in this section focus on stimulating technological change through direct investments in technology innovation. This focus on "supply-push" (supporting research, development and demonstration) is a contrast to the rest of the programs evaluated at this workshop, which focus on "demand-pull" (changing market conditions). Technology-push approaches may be a critical pathway for the transition to a sustainable industrial society. Like other programs evaluated in this workshop, these R&D programs were innovative in their use of voluntary and collaborative approaches to reach their goals. Two papers were presented during the session. The first one focused on R&D collaboration in the power sector in the United States (by Vicki Norberg-Bohm and Robert Margolis). The second paper evaluated the Danish Cleaner Technology Programs (by Ulrik Jørgensen). The commentators for the session were Jerry Rogers and Nils Thorsen.

The first paper focused on three U.S. Department of Energy (DOE) R&D collaborations in the power sector: the Advanced Turbine Systems (ATS) program, the Photovoltaic Manufacturing Technology (PVMaT) project, and the Thin-Film PV Partnership project. The goals of these programs were to support the development of a next generation of technology, and included support for innovations in technology systems, technology components and manufacturing processes. Each of these programs included collaborative planning processes as well as collaboration in implementing the R&D programs. The collaboration involved multi-stakeholder partnerships, including companies, governments, Congress, universities, national laboratories, and end-users. The participants from the private sector and the government officials involved in these collaborations viewed them as highly successful, and a good model for future government R&D programs.

Several lessons emerge from these three R&D collaborations. Norberg-Bohm and Margolis argue that from the standpoint of the environment, R&D collaborations will be most effective if they engage industry and other stakeholders in a planning process that leads to the establishment of "stretch" goals, i.e. technological goals with environmental benefits that are beyond what is required by regulation and what the private sector would pursue on its own. In terms of implementation, government-industry partnerships can result in both risk spreading and risk reduction. Cost-sharing was the key contributor to risk-spreading in these programs. Although this is not exclusively an element of collaborative programs, when done in the context of these R&D collaborations, cost-sharing helped to keep firms working on a goal that was a stretch technologically, even in the face of technological setbacks. The programs contributed to risk reduction (improved technological success) by expanding the range of actors involved in addressing the research challenges, in particular by mobilizing universities and national laboratories to focus on industry-relevant problems.

The second paper examined cleaner technology programs in Denmark. The Danish government support for cleaner technology innovation and demonstrations was initiated in 1987 with the Development Program for Cleaner Technology. The aim of the program was "to reduce the strain on the environment through preventive efforts with the aid of improved incentives to employ cleaner technology." The program offered grants to support identification, development, demonstration, and full-scale implementation of cleaner technologies. Support for this approach continued through a series action plans throughout the 1990s. Toward the end of the decade, there was a shift in policy focus from cleaner technology to cleaner products.

Jørgenson reports that the Danish collaborative approach to technology innovation and diffusion has had a measurable and significant impact on the availability of cleaner technologies. However, the diffusion and implementation of these technologies, while significant, has not reached its full potential. For example, in the area of volatile organic compounds, an environmental problem given high-priority in the initial program, only 25 to 40 percent of potential reductions in pollution have been achieved. The basic difficulty is that local authorities, which provide facility permits and have significant discretion in the Danish environmental policy system, have either not learned sufficiently

about new technological options from the clean technology programs or have not forced the implementation of these cleaner technologies during their permit negotiations with industry. In sum, the cleaner technology programs have not succeeded in fundamentally penetrating and changing the traditional command-and-control approach to environmental regulation.

The key themes brought out in this session through the presentations and discussions included: the role of technology development programs in environmental policy, the effectiveness of voluntary and collaborative approaches in a competitive free-market environment, balancing near and long-term goals, and the issue of diffusion of new technologies.

Regulation and economic motives alone, despite evidence of "win-win" opportunities, have not created adequate motivation for firms to develop cleaner technology on their own. This is for several reasons. First the markets for environmentally enhancing technology are often quite uncertain, as they are dependent on government policies. Second, regulatory goals can often be met with existing pollution control technologies. Third, new technologies can face difficulty in the permitting process. Fourth, once available new technologies may be required by regulation. Therefore, it is not always in the self-interest of firms to invest heavily in environmental technology development.

Government clean technology programs offer incentives to the private sector to improve the environmental characteristics of their process and products. These government programs can enhance the development of networks of technological capability providing opportunities and incentives for manufacturers, suppliers, universities, national laboratories, and consultants to work together to reduce risks. They do this by setting challenging goals that require collaboration and by providing funding and requiring organizational structures that increase collaboration amongst firms and other actors with technological capabilities.

A key question raised in the discussion was how these programs balanced competition with collaboration, and the related concern of how firms can engage in collaboration while protecting their competitive interests. The programs evaluated in this session suggests that competition remains the dominant form in these programs, with collaboration contributing to move technology forward at a faster pace and in a direction that reduces environmental impacts. Thus, firms collaborated on planning processes for goal setting, pre-competitive aspects of technological development, and generic technological components that were too risky to be developed by a single firm but necessary for the success of all firms. The large majority of funds in these programs were not spent on the collaborative aspects, but rather on the competitive, cost-shared contracts between government and individual firms, in which the individual firms maintained intellectual property rights.

One of the challenges for "supply-push" approaches is to balance near term and long-term goals. In partnering with firms, and particularly when requiring cost-sharing, firms will try to pull the research closer to the market. Thus, these types of collaborations are

potentially powerful instruments to reach near-and mid-range goals. Different approaches would be necessary to address long-run technological innovation for the environment, including "road mapping," sustainable technological trajectories, and then setting research agendas to move along those trajectories. While it may make sense to involve industry, one would not expect the same types of cost-sharing nor to relinquish as much of the decision-making to the private sector for longer-term research agendas.

The discussion focused extensively on the relationship between cleaner technology programs and long-term goals in environmental regulation. The U.S. collaborative R&D programs presented on this panel took place in the Department of Energy and were quite separate from the environmental regulatory function. The ATS program included EPA officials in the goal-setting process. While EPA officials were excited about the goals, they were unable to predict or make guarantees about future emissions requirements; in other words there was no guarantee that when the new technology was available in eight years that it would be meeting emission requirements. In this case, emission requirements ratcheted down over the development period and were stricter than the emission levels attained by the new technology, despite the fact these were much lower than the previous generation of gas turbines. The lessons to take from this experience is the need for on-going re-evaluation of environmental targets in a dialogue that involves a broader range of stakeholders, including not only the federal EPA, but also regional EPA offices, state environmental regulators, and environmental interest groups. This issue has been observed in other R&D collaborations, such as the Program for New Generation of Vehicles, and was called by one of the workshop participants "the regulatory treadmill." Over the time frame of technology development (often a decade or more), our knowledge about environmental impacts will increase and may result in more stringent environmental goals—technology programs need to be designed with this possibility in mind.

Two central issues concerning diffusion were raised during the discussion. The first one related to the design of the programs and the partnerships involved. The second issue concerned the fit with the rest of the policy system. Both the Danish and U.S. experiences suggest that it is important to design technology partnerships in a manner that links the R&D function with the business organization. In the U.S. ATS collaboration, an explicit decision was made to run the program through the business organizations rather than corporate research labs, as a mechanism for insuring that firms made a commitment to commercialize the technology. In the Danish cases, diffusion of innovation technologies did not occur if there was laboratory testing and not a follow-up project to commercialize the technology. If the partnerships involved consultants or suppliers with a commercial interest in marketing the results, this led to much better diffusion. Thus, the choice in partnerships for technology development has a large impact on diffusion. The three US cases suggest that the specific role that should be played by each partner depends on the technological and organizational capabilities that they can bring to the table, and this may vary considerably from one industry or technology to another.

With respect to the second issue relating to diffusion—the fit with the rest of the policy system—the discussion focused on the issue of creating leading firms and bringing forward laggards. When the government is involved in developing "stretch" goals in partnership with industry, and puts the money on the table to share the risk of reaching these goals with the private sector, it creates an incentive for all firms in an industry to participate in the program. On the other hand, if the technology program is set up as voluntary and there are not sufficient incentives for laggards to adopt newly developed technology, the potential leaders may choose not to participate. This suggests that cleaner technology programs need to be well integrated with other policies and regulatory programs that create markets for the emerging cleaner technologies.

Although this sounds like a relatively logical and simple thing to do, as discussed by Jørgenson, the experiences with the Danish cleaner technology programs show how difficult this is in practice. The programs were explicitly seen as a way to overcome some of the shortcomings of the existing command and control system. Yet despite the intentions of making cleaner technology a core concept in Danish environmental policy, after 15 years, two different worlds of regulatory efforts continue—the government centered command-and-control on the one hand and the voluntary and market-based technology policies on the other. The fact that a coherent practice has not emerged from the 15 years of experience points to difficulties in transforming the entrenched regulatory regime through a voluntary program. A particular difficulty is the lack of understanding of the administrative efforts needed to sustain cleaner technology based regulation as a distinct regime, as well as not addressing the conflict between cleaner technology goals and in the existing command-and-control regime.

In sum, collaborative approaches for technology development that included significant cost-sharing between the public and private sectors appear promising for creating new technological options. The partnerships, which involve industries, governments, national laboratories, universities, and end-users, seem especially useful in reaching near- or mid-term goals. Design elements for successful collaboration include setting challenging goals that require collaboration and government cost sharing to reduce risk, requiring organizational structures that increase collaboration amongst firms and other actors with technological capabilities and that link the R&D function with the business organization. Other models may be needed to reach long-range technological goals. Even within the context of mid-term technological development, there are difficulties in setting technological goals that will be adequate in the face of new knowledge about the need for improved environmental protection. Furthermore, changing the dominant system of environmental regulation in order to provide incentives for the development and wide-spread diffusion of cleaner technologies remains a challenging task.

INFORMATION DISCLOSURE

The two papers presented on this panel represent one of the first environmental information disclosure programs, the U.S. Toxic Release Inventory (by Mary Graham and Kathryn Miller), and one of the newest and most far-reaching environmental information disclosure programs, the Norwegian Accounting Act of 1998 (by Audun

Ruud). In both of these cases, information disclosure is mandatory. One of the commentators, Bob Massie, presented information on the Global Reporting Initiative (GRI), a voluntary, non-governmental disclosure program. Thus our discussion was able to focus not only on the design and effectiveness of government-mandated information disclosure for the environment, but also on the strengths and weaknesses of mandated versus voluntary approaches. The other commentators for this session were Mark Greenwood and Rolf Marstrander.

The first paper on the panel evaluated the impact of the U.S. Toxics Release Inventory (TRI). The TRI was created in 1986 as part of the Emergency Planning and Community Right-To-Know Act. After several amendments during the 1990s, the TRI now requires most medium and large-scale manufacturing firms to provide facility level data on releases of 602 chemicals to all media (air, water and land), as well as on-site and off-site storage, treatment, disposal, recycling and energy recovery. It also requires firms to report qualitatively on source reduction activities and to provide a production index, so that changes in releases and transfers can be related to changes in production.

The TRI is heralded as a major success, and an important contributor to a 45 percent reduction in releases of listed chemicals by 1998. As Graham and Miller discussed, the TRI, however, cannot be given credit for this entire decline. A variety of regulations enacted since 1986, as well as other factors, have influenced firms' decisions to reduce toxic emissions. Furthermore, the environmental significance of this decline requires interpretation. Relatively few facilities cut releases by reducing waste at the source (although positive examples of real preventive action do exist); rather recycling increased substantially. Also, releases declined at a much more rapid rate in early years, raising questions about the long-term impact of this policy approach. Despite these caveats, the TRI was clearly path-breaking legislation which has contributed to toxic emission reductions and provided lessons for future information disclosure policies that followed.

The second paper examined the Norwegian Accounting Act (NAA) of 1998. This act requires the Board of Directors of all commercial firms subject to external auditing requirements to disclose environmental data on activities that may cause "a not insignificant impact on the external environment." The NAA goes beyond the requirements for reporting on plant specific pollution control, which forms the basis for the Norwegian Pollutant Release and Transfer Register, by requiring firms to report on the life cycle environmental impacts of their products. In essence this means that firms have to report on inputs, and releases for both the production process and their products.

The Norwegian Accounting Act is too recent to fully evaluate its impact on environmental disclosure or firm behavior. A report assessing its first year of implementation (1999) drew the conclusion that few firms were fully complying with the act. As outlined by Ruud, the issues here are twofold: to get firms to report on environmental impacts beyond the emissions data they are already reporting as required by the Pollution Control Act, and to get firms to take a lifecycle approach, reporting on the environmental impacts of inputs and product use, as well as future plans. This is admittedly a tall order, and one made more complicated by the fact that although the act

requires this information in the annual report, it does not require the third party auditor to validate the environmental portion of the report. Thus, the engagement of a third party as educator, implementer, and enforcer is not part of this legislation, making environmental reporting requirements still quite distinct from financial reporting requirements.

The discussion examined the mechanisms through which information disclosure policy works, and the role of information disclosure as part of a dynamic system of regulation. It then turned to design issues, including legitimacy, accuracy, consistency, comprehensiveness and utility.

There are two major pathways through which mandatory public disclosure systems are effective: by producing external pressures on firms and by changing internal decision-making. External pressures include both economic and political pressure. Economic pressure can be brought by several actors: 1) investors who may want to limit their exposure to companies with large environmental risks, 2) consumers who purchase green products and 3) workers who place extra value in working for firms that are environmental leaders, making it possible for those firms to attract and keep the best workers. Political pressure can be exerted by environmental and non-governmental groups as well as local and state legislatures. In terms of internal decision-making, information disclosure systems can force firms to develop new information that leads them to discover win-win opportunities for reducing environmental impacts while improving competitiveness. A key issue for thinking about information disclosure as a tool for industrial transformation is whether firms pursue improved competitiveness only through immediate cost savings from pollution prevention, or whether firms also look for longer term and less easily achievable technology innovations. Although one can find anecdotal evidence to support each of these pathways, it appears that the former is most common.

The effectiveness of information disclosure policy is perhaps best understood when information disclosure is viewed as part of a dynamic system of regulation, in which the level of regulation is established by best practices through voluntary action by firms. Although information disclosure is mandatory in systems like TRI, the emissions being disclosed are legal emissions, and thus actions to reduce these emissions are voluntary. Some firms have reacted to information disclosure by becoming leaders in reducing hazardous emissions. Once leading firms have taken voluntary actions it is often possible for the government to ratchet up the regulatory baseline. Furthermore, disclosure may reveal heretofore unknown environmental hazards which business and/or governments (perhaps through citizen pressure) will choose to regulate.

As reported by Miller and Graham, several aspects of the design and implementation of TRI enhance its legitimacy. Firms are required to report their releases annually in a standard format, the emission sources are identified at the facility level, and information is disclosed to a broad audience, with electronic disclosure mandatory. In implementing TRI, EPA went to great lengths to insure the accuracy of information, making TRI the "most accurate database at EPA" (statement by commentator). U.S. EPA has an inspection program for TRI and many guidance manuals. EPA also runs internal checks

to assess and improve the consistency of the data (i.e., whether the data makes sense in terms of year-to-year changes). EPA's efforts to ensure accuracy have contributed to the high legitimacy that the TRI data has with its providers and users.

Despite EPA's efforts and the generally positive evaluation of TRI data, one difficulty in using the TRI data to evaluate trends in toxic emissions is a lack of consistency. Firms can choose how to account for certain emissions (not all emissions are monitored, thus many are based on estimates rather than data). From year-to-year, firms may change how they estimate emissions. Creating consistency, both within and between firms is an important design concern for information disclosure schemes.

Comprehensiveness is also an important feature if environmental information disclosure systems are to provide incentives for improved environmental performance. One of the strengths of the TRI is that it is a multimedia approach, and thus provided an incentive not to transfer emissions from one media to another. However, in other respects it was not comprehensive: it did not address many sources of toxics (such as mobile and smaller sources, which would be difficult to address through this type of program) and it did not cover toxic use (only releases). Many reporting programs are not comprehensive and focus only a piece of the environmental puzzle. Efforts such as the GRI are trying to overcome this lack of comprehensiveness. The Norwegian Accounting Act makes a step in this direction by requiring a lifecycle perspective.

In information disclosure policy, there may be a tension between breadth and depth in reporting. Politics are likely to keep mandatory reporting schemes more delimited, whereas more comprehensive voluntary schemes may have fewer users. Within the context of information disclosure policy, it is worth considering whether the goal is to encourage environmental management pioneers or reform environmental laggards, i.e. are we trying to develop floors or create incentives and opportunities to raise the ceiling.

A final design concern is utility - how to design information disclosure systems so that they are useful to a variety of stakeholders in their efforts to improve environmental performance. At the workshop, we considered utility in priority setting, in support for other environmental policy and programs, and for decision-making inside the firm. In terms of priority setting, some participants argued that TRI already provides information that can support priority setting, while others pointed to limitations because the TRI is not a risk-based ranking. The TRI requires disclosure of the pounds of chemicals released, and thus does not create incentives to reduce emissions from the riskiest chemicals first. Given the great uncertainties and ignorance in our knowledge of the risk posed by specific chemical releases, it would not be possible at this time to create a "government approved" risk-based disclosure mechanism. While some see this as a reason to critique TRI's usefulness for priority setting, others view this as a valuable approach that supports transparency. Those who want to move to create risk-based reporting can apply the risk factors they choose in combination with the TRI data to create risk rankings.

Information disclosure can also be used to provide an underpinning for other policies and programs. For example, the TRI data was used as a baseline for the 33/50 program, a

voluntary program, which challenged firms to reduce their emissions of 17 chemicals on the TRI list, first by 33 percent and then by 50 percent within a 5-year time period.

Information disclosure policies will be a stronger impetus for change if they require firms to develop information that is useful internally. Many argue that the most important aspect of information disclosure policies is that they require firms to develop information about their resource use and emissions that they do not currently have and which can be used to identify opportunities for achieving greater efficiency in production while reducing environmental impacts. If the information disclosed is useful internally, firms are more likely to develop credible information and to keep the additional costs imposed by the program to a minimum. The requirement of the Norwegian Accounting Act concerning the statement by the Board of Directors is especially interesting here, since it might move the attention for environmental matters more into the core of company, and away from just the environmental staff department. Of course, at this point we can only speculate about its outcomes.

The Norwegian Accounting Act requires the reporting of future plans. Although the TRI does not require this, some U.S. state-level programs require that firms submit future plans, although they are not released the public. Businesses may have legitimate concerns about reporting their future plans, as this could perhaps compromise competitiveness. The public interest in having future plans developed and reported is to put environmental concerns into the planning process of firms. Models for doing this are still evolving, and it is not clear how well Norwegian firms will accepted the prospective disclosure.

There was also considerable discussion about the different roles that can be played by public mandatory information disclosure systems, such as those presented on this panel, and private voluntary information disclosure systems (e.g. GRI). Some participants suggested that we have to rethink our current approach to the public-sector/private-sector dichotomy and consider the multiple ways in which the public sector and the corporate sector interact. Some participants emphasized that there is a strong and growing private sector market for information disclosure and that the private and non-profit sectors are ahead of government, both as advocates for information disclosure and as users of this information. Thus, thinking about government requirements as the only powerful driver of information disclosure misses an important part of the picture.

Cultural differences can be important when considering the political potential of government mandated information disclosure programs and the effectiveness of these programs. Some governments may be better able to mandate and legitimize information disclosure, and some publics are more likely to view government efforts as legitimate and to mobilize based on the results of the data. The effectiveness of information disclosure policy thus depends not only on accuracy and legitimacy in the collection and dissemination of data, but also on the mobilization of the set of stakeholders that can use data to support decision-making and press for change.

Overall, the evidence presented and discussed in this session suggests that information disclosure programs can be a powerful force for environmental improvement. Information-based programs seem to be especially suited for enhancing more and better informed

dialogue between stakeholders and can be used to facilitate multi-stakeholder processes. NGOs might act as agents of public interest, governments as potential regulators and companies as the parties with the information needed to facilitate changes in production. Information disclosure can also create a basis of information that can be used by a variety of stakeholders for internal priority setting. Effective information disclosure policy must be designed for legitimacy, accuracy, consistency, comprehensiveness and utility. However, the effectiveness of information disclosure policy depends not only these characteristics, but also on the mobilization of a set of stakeholders that can use data to support decision-making and press for change.

Further experimentation with design could make information disclosure programs even better tools for industrial transformation. Concerns were raised about the ability of the TRI approach to stimulate long-term investments for pollution prevention, rather than short-term efforts to quickly reduce emissions. Requirements for a lifecycle perspective, reporting of future plans, and approval by the board-of-directors as in the Norwegian Accounting Act, represent possible remedies.

ENVIRONMENTAL MANAGEMENT SYSTEMS

The session on Environmental Management Systems (EMS) focused on two different approaches for using EMS in environmental policy. The first paper, written by Jennifer Nash, examined StarTrack, a U.S. program that used the adoption of EMS as one criteria for participation in a tiered system of environmental regulation. The second paper, by Andrew Gouldson, focused on the implementation of the European Eco-Management and Audit Scheme in the UK, a policy that encouraged the adoption of EMS. The commentators for this session were John Harris, Martin Baxter and Dan Fiorino.

StarTrack is an example of using the adoption of EMS as part of a tiered system of environmental regulation. The basic premise behind StarTrack, and tiered systems of environmental regulation more generally, is that the environmental authorities offer participating firms regulatory relief and public recognition in exchange for superior environmental performance. For firms to enter the StarTrack program, they had to have a history of compliance and pollution prevention, an EMS or a commitment to adopt an EMS, and a commitment to continued improvement in environmental performance. As part of StarTrack agreements, facility managers promised to undertake audits of internal management and compliance performance, have these audits certified by an independent third party, and publish performance reports. In exchange, EPA managers promised to forego inspections, offer penalty amnesty, provide faster permitting, and publicly recognize StarTrack facilities as environmental leaders.

Nash concludes that while the idea of tiered environmental regulation is relatively simple, implementation has raised a complex set of issues. One of the main problems was defining superior environmental performance—a facility's environmental performance has many dimensions, past behavior does not necessarily predict future conduct, and having an EMS does not necessarily imply strong performance. A second problem is that the benefits EPA provided were less than the agency had promised and not very

meaningful to firms. Furthermore, the transaction costs were very high, with the program increasing rather than decreasing agency oversight. Nash concludes that unless these issues can be resolved, tiered environmental programs are unlikely to result in tangible benefits.

The second paper focused on the implementation of the Eco-Management and Audit Scheme (EMAS) in the UK. EMAS is a regulation of the European Union (EU), which aims to build capacity for environmental protection and increase the environmental protection activity within firms through the adoption and third-party verification of environmental management systems. EMAS is a voluntary scheme; companies may choose to register their sites if they comply with the requirements of the scheme. EU member states were given two years to establish the necessary institutional structures to administer the scheme at the national level.

Gouldson reports on the implementation and the effects of the regulation in the UK. Although companies in the UK are implementing EMS on a relatively wide scale, very few have registered for EMAS and most that have registered for EMAS have previously been certified for ISO 14001. Thus, it was difficult to isolate the effects of EMAS from other EMS systems. The empirical analysis in the paper suggests that having EMAS did raise awareness of the need to innovate and help develop capacities for technological change. However, most of the innovations within EMAS registered companies were low-tech and organizational changes, i.e. incremental innovation. While the capacity for more radical change exists in some firms, external incentives or imperatives that could lead to the actual utilization of this capacity are often lacking. Gouldson concludes that these drivers for change, including the decision to adopt EMAS, have come from the wider range of incentives for improving environmental performance. In this regard, EMS can only be effective as part of a wider set of environmental policy mechanisms that not only build capacity, but also include incentives and imperatives for improved performance.

During this session, the comments and discussion focused on three major issues: the value of EMS to firms, the effects of EMS for the environmental performance of firms, and the role of EMS in government policies.

There was considerable debate on the value of an EMS in stimulating improved environmental performance. The papers and discussion highlighted the following potential benefits from EMS adoption: increased capacity for environmental improvement, increased awareness of the need for innovation for the environment, identification of "win-win" opportunities for environmental improvement, and better compliance with environmental regulation.

Furthermore, as the environmental affairs within companies have become more expensive and complicated over the last decades, EMS have become a valuable, perhaps even essential management tool. This more complicated situation is due not only to increases in government requirements, but also because of increased scrutiny and interaction with a broad range of stakeholders including environmental interest groups, community groups, shareholders, boards of directors, insurance companies and

investment companies. As stakeholder demands and input is increasing, companies have a need to increase information flows as well as the transparency and legitimacy of information. An EMS is one of the tools companies can use to satisfy this need. EMAS' focus on third party verification and external communication seemed particularly helpful in this regard, improving companies' image with their stakeholders.

Despite the many benefits, the empirical evidence in the papers does not suggest a causal link between having an EMS and a strong environmental performance. In other words, there is little in the papers or discussion at the workshop suggesting that EMS represent a sufficient condition for industry to move down a pathway to sustainability.

In terms of effectiveness, two key criticisms were voiced about the current approaches to EMS. The first was that EMS schemes such as EMAS and ISO 14000 are overly bureaucratic. As stated by a participant in StarTrack, "EMS are merely a distraction, they tend to lead to administrivia and paper chase." The full-blown EMS may also be less relevant and applicable to SMEs. For SMEs, the basic feature of EMS, to control and document your environmental management, may be achieved by other, less formal means. One example is waste minimization methodologies that focus more directly on the material flows within companies rather than on the managerial perspective as in ISO 14000. There was also concern that, like TRI, an EMS has strong influence only when first adopted, with benefits decreasing overtime as the system becomes institutionalized.

Concluding that an EMS can be a valuable tool for companies does not provide adequate guidance on the role of government in promoting the adoption of EMS or in using EMS adoption as part of regulatory strategies. With regard to government promotion of EMS, the discussion covered three questions. Should government take a role in promoting EMS? If yes, what types of EMS should government programs promote? And what types of benefits can governments offer firms that adopt EMS?

While some firms adopt EMS without government promotion, others do not and may benefit from government EMS programs. Different approaches to EMS may be needed for the group of SMEs (as discussed above), which are least likely to adopt EMS on their own. Given that an increasing number of larger companies, and especially the more pro-active ones, are already progressing with the implementation of an EMS simply based on internal needs, some participants questioned the additional value of promoting EMS to these firms. One response to this skepticism is that government certified EMS schemes can provide some benefit beyond the weak benefit of public recognition. Specifically, when combined with third-party verification and external reporting, it can be an effective tool for communication with stakeholders (e.g. EMAS, as discussed above). Characteristics identified as contributing to the effectiveness of government sponsored EMS included: third party verification, requirements for comprehensive and regular public reporting, and requirements for future planning for continued environmental improvement. Governments may also consider asking firms to report on their progress toward specific environmental goals.

In terms of benefits offered to adopters of EMS, our two cases were quite different. For EMAS in the UK, the only benefit offered was public recognition. Other member states

of the European Union (most notably Germany), however do use EMAS in tiered systems of environmental regulation. For StarTrack, the government was hoping to use EMS adoption as one component of a tiered program aimed at stimulating improved environmental performance in exchange for public recognition and regulatory relief. In both the U.K. and the U.S. programs, it proved very difficult for the government to offer meaningful benefits. In particular, many workshop participants expressed the view that positive recognition is not a sufficient motivator to firms to participate in government-sponsored EMS programs or tiered regulatory programs. For StarTrack, a further difficulty was that the government could not come through on its promises of regulatory relief (in the form of decreased monitoring and fast-track permitting), since there were strong legal and policy objections from enforcement officials and NGOs.

The new U.S. federal program of tiered environmental regulation, Performance Track, has worked to provide additional benefits including a best practices database, low priority for inspections, and streamlined reporting and increased flexibility. Time will tell whether it can be more successful than StarTrack in coming through on its promises. In addition to the types of legal and policy objections faced by StarTrack, Performance Track faces potential difficulties due to the federalism of U.S. environmental policy. Most national environmental legislation is implemented by state governments. This federalism works against national policy innovations that are not part of legislation, as state governments have no obligation to participate.

Performance Track has also reconceptualized the use of EMS in tiered regulatory systems. Given that the main benefit of EMS adoption is to build internal capacity, then EMS needs to be envisioned as a way of doing business and a way to build capacity rather than thinking of it is a measure of environmental performance. If this is a case, it cannot be depended on as the key criteria for tiered environmental system approaches. Rather, having it as a requirement for government programs may be a way to improve the policy networks (due to the information exchange if reporting and verification are required), while other measures are used to identify superior environmental performance. This suggests some role for government in promoting EMS.

In sum, EMS's major effects are to increase the capacity for change, increase awareness of the need for innovation for the environment, and to help firms identify "win-win" opportunities for environmental improvement. In this respect, they can be a valuable part of public policies. Given that the actual drivers for change have to be found elsewhere, EMS programs can only be expected to play a supporting role in the wider policy context. As shown by the Dutch policy program on EMS that was presented in the session on voluntary programs, EMS as a supporting program can be an effective part of a larger government strategy. Several characteristics that contribute the to the effectiveness of government-sponsored or supported EMS are: third party verification, comprehensive and regular public reporting, and requirements for future planning for continued environmental improvement, including progress toward specific environmental goals. While there is currently much interest in linking the adoption of EMS with regulatory relief in tiered systems of environmental regulation, EMS are not an adequate criteria for establishing superior environmental performance.

CONCLUSIONS

When environmental degradation emerged as a priority for government action in the early 1970s, most countries enacted media-specific legislation based on direct regulation (i.e. ambient, emission and technology standards enforced through permitting systems). Although direct regulation has been a powerful tool for adjusting industrial behavior, its disadvantages soon became apparent: shifting pollution from one media to another rather than eliminating pollution, constraining innovation, difficulties with enforcement, inadequate or incorrect priority setting, and high transaction costs. Furthermore, direct regulation has been criticized for being inadequate to address the challenges of sustainability. By the mid-1980s, this critique of the environmental policy system led to calls for change from business, government and NGOs. Proposals for change ranged across a broad spectrum: from adjustments to direct regulation and use of market-based mechanisms to the development of the types of policy innovations examined in this workshop - Voluntary, Collaborative, and Information-Based approaches.

At first brush, as a group the programs examined in this workshop are defined best by what they are not: neither direct regulation nor economic instruments. But this distinction is more than simply a negation, as these programs were attempts to engage industry in significant environmental improvements through dialogue, consensus-building and voluntary action rather than the imperatives of direct regulation or the incentives of market-based approaches. Admittedly, in practice there was a wide range in the degree to which these programs were truly independent of imperatives and incentives, a theme that will be discussed further below. For the purposes of the workshop, these programs were all chosen because they were conceived as an alternative or significant addition to the existing command-and-control system (which was judged inadequate) and to environmental taxes (which had limited support from industry or the public). They were created with high expectations of their ability to stimulate significant improvements in the effectiveness and efficiency of environmental protection.

Although the workshop was divided into separate sections on voluntary, collaborative, and information-based strategies, in practice the programs all contained at least two of these characteristics, and some contained all three. Furthermore, despite a common use of terms such as voluntary and collaboration, in practice these concepts were applied in multiple ways. In this conclusion, we examine first the lessons learned about each of the three characteristics: voluntary action, collaboration, and information strategies. This discussion will also clarify some of the linguistic issues raised at the conference regarding what is meant by these terms. We then discuss factors that influence effectiveness, highlighting cross-cutting issues from the workshop. We finish with an overall assessment of the usefulness and attractiveness of these new approaches. This conclusion does not attempt to provide a "how to" guide for designing these types of innovative programs. Rather, it tries to highlight important conceptual issues that should be considered in future uses of voluntary, collaborative, and information-based approaches in environmental and energy policy.

Characteristics of the new environmental and energy policy mechanisms: voluntary action, collaboration, and information strategies

The first characteristic, *voluntary action*, provides individual firms the right to choose whether or not to participate in a program. The term voluntary was used in two distinct ways at the workshop. The most common and straightforward use of the term voluntary is to describe programs that ask firms to voluntarily improve their environmental performance in exchange for benefits such as recognition, cost savings, and regulatory relief. In these programs, there are no sanctions against firms that do not step forward. Project XL and StarTrack in the United States, and the Dutch promotion of EMS and EMAS implementation in the U.K. are examples of this type of voluntary program. The term voluntary was also used in a second context to describe programs, such as the German End-of-Life Vehicle Program, which provided a group of firms within an industry sector the opportunity to develop a voluntary agreement to reach environmental targets. This second type of voluntary program, while preserving the right of firms to choose whether to participate in this sectoral effort provided direct regulation as an alternative if a voluntary agreement was not reached. In other words, while negotiating a voluntary agreement, firms were on notice that they would be required to take action, regardless of the outcome of the voluntary effort.

Strictly voluntary programs (the first type discussed above) can be effective in stimulating firms to take win-win actions that the firms would not have identified without the intervention of a voluntary program. Beyond this, and from the standpoint of more fundamental industrial transformation and technological innovation, voluntary programs will be most effective if they are tied to incentives or imperatives for action. These can be either integral to the voluntary approach, as evidenced in the German End-of-Life Vehicle Program, or through policies external to the voluntary approach.

External incentives can take a variety of forms. For example, voluntary programs (e.g. Dutch EMS) can be quite successful for capacity building, but in this case external pressures for improved environmental performance (as found in the Dutch target-group policy) create the need for increased capacity. In the case of Energy Star, incentives were created by pursuing procurement policies and mandatory standards along with the voluntary negotiation, as well as consumer education through labeling, thus creating a risk for nonparticipating firms of falling behind the technological frontier and losing market share. In addition to the risk of falling behind technologically, an additional incentive found in technology programs (U.S. R&D collaboration and the Danish Cleaner Technology Programs) was government cost-sharing for research, development, and demonstration. In sum, interaction between the voluntary programs and the rest of the environmental policy system is crucial.

The second characteristic is *collaboration*. Over the past decade, collaboration has been held up as a new model for environmental policy. All of the policy innovations examined in this workshop depended on or resulted in increased collaboration between stakeholders. Some explicitly required collaboration in the decision-making process, bringing together private sector, government, and in many cases NGO representatives to negotiate (e.g. Dutch Target Group, German End-of-life Vehicles, U.S. R&D

Collaborations, U.S. CSI and U.S. Project XL). Others created collaboration through implementation that explicitly aimed to increase the network of actors involved in environmental protection activities (e.g. the Dutch EMS, the Norwegian Accounting Act, and the Danish Cleaner Technology Programs). Still others resulted in industry choosing to increase its interaction with stakeholders (e.g. U.S. TRI).

There are several benefits and motivations for this increased collaboration. First and foremost, collaboration can bring new perspectives and knowledge to the policy process, resulting in better solutions than parties can create individually. Governments are looking to collaboration as a way of mobilizing the knowledge and creativity of industry. For industry, collaboration on environmental matters has become a reality over the last decade due to an increased scrutiny and interaction with a broad range of stakeholders including environmental interest groups, community groups, shareholders, boards of directors, insurance companies and investment companies. Building networks or activating existing ones can also be an effective way to reach specific actors, for example SMEs (Dutch EMS Program, Danish Cleaner Technology Programs).

One key issue raised in the workshop was decision-rules in collaborative processes, particularly the efficacy of consensus-based decision-making. The cases indicate that consensus-based approaches are more likely to be effective if they are used to implement clear goals that are externally-imposed (e.g. Dutch Target Group) or externally-mediated (e.g. German End-of-Life Vehicles, U.S. R&D Collaboration; Energy STAR) goals. Otherwise, consensus-based negotiations are likely to lead to lowest-common-denominator solutions or stalemate, as evidenced by the relative failure of two of the bold U.S. experiments in regulatory reinvention (Project XL and CSI).

The third characteristic is *increased information flows*. All the programs examined in this workshop were information intensive, that is they required increased development and dissemination of information on pollution emissions and sometimes other aspects of industrial behavior that affect the natural environment. In the information disclosure programs (TRI and the Norwegian Accounting Act), increased information flows were mandated by law. Although not always mandatory, information disclosure is also a critical component for many types of voluntary and collaborative programs, as they rely on transparency in both negotiation and as part of monitoring schemes. In addition to disclosure, information development has also been pursued, for example in EMS programs (EMAS, Dutch EMS program), to build capacity inside companies.

Information disclosure can be used to provide both positive and negative recognition, and through this create pressures both within firms and external to firms for improving environmental performance. In terms of external pressures, the programs provided several models for the use of positive recognition. The Energy Star program shows that positive recognition through labeling, when combined with other policies that influence consumer choices (e.g. procurement policy) can be effective. The EMAS program demonstrates that independently verified information can be valuable to companies in their dialogue with their stakeholders, although this value may not be too great, as evidenced by low levels of participation in EMAS. Similarly, in the United States, the

positive recognition offered by Project XL and StarTrack did not provide an adequate motivation for participation. Further work is needed on understanding whether positive recognition can be a powerful stimulus for improved environmental performance, and if so, how and under what conditions.

In terms of negative recognition, the TRI shows that negative recognition can be an effective motivator of change. The key issues remaining are considering how to use negative recognition to stimulate long-term and pollution prevention approaches, rather than short-term efforts to quickly reduce emissions, and the accompanying negative publicity. Requirements for a life-cycle perspective, reporting of future plans, and approval by the board-of-directors (as required by the Norwegian accounting act), represent new efforts in this direction.

Looking at information as a motivator for internal change, the key issues addressed at the workshop were to design information policies in ways that create information that is actually useful internally to a firm. Private-sector participants of the workshop expressed concern that the burgeoning of reporting schemes, both government sponsored and privately sponsored, was creating an administrative burden with little resulting added value. In countering this, it was noted that we are in a period of experimentation, and it may be too soon for standardization. Nonetheless, the key point is that information disclosure program should be designed to maximize the capacity building within firms and minimize the transaction costs.

Effectiveness: Crosscutting issues

The presentations and discussions at this workshop explored the differences and similarities in the design and implementation of these new approaches. The body of this report examined lessons for the design and implementation of specific types of programs, as well as unresolved concerns. In this section, we examine cost-cutting issues and concerns, including the integration of the new approaches with the rest of the environmental policy system, the tension between long-term commitments and flexibility, transaction costs, and the need for increased monitoring and evaluation.

Integration with the Environmental Policy System

Throughout this report, we have pointed out the value of integrating these new approaches with other policies and programs. The discussions during the workshop identified three reasons for looking carefully at the ways in which these new approaches interact with the rest of the environmental policy system: (1) the need for incentives external to the programs, (2) the need for different approaches for leaders and laggards, and (3) the need to change the dominant regulatory system.

First, the imperative for change is often external to the programs. The programs that we have discussed are therefore likely to be most effective when used synergistically with or as a complement to other policy approaches, particularly policy approaches that can provide incentives (or disincentives) to action. One often-cited example of this is the provision of a credible threat of regulation. However, a threat of traditional "command

and control" approaches is not the only complementary mechanism available to governments. Other mechanisms that were reported included government cost-sharing in technology development programs, public procurement policies and consumer education.

A second reason for developing an integrated set of policies is that a uniform policy approach cannot cope with the diversity across firms. Laggards need a different strategy than pro-active companies. If a program is set up as voluntary and there are not sufficient incentives for laggards to adopt newly developed approaches to environmental protection (including new technologies), the potential leaders may choose not to participate. In sum, these new approaches need to be well integrated with regulatory programs that will force free riders to comply with innovative approaches and in doing so create markets for environmentally superior technologies.

Third, for the new programs to have a strong impact, they have to work in tandem with the dominant regulatory system. In almost all Western countries, direct regulation is still the dominant approach to environmental policy. All the programs examined in this workshop represent efforts to overcome the limitations of this "command-and-control" system, many with ambitions of creating new regulatory regimes. But changing the existing approach to environmental regulation is a tall order. For example, the Danish clean technology programs and Project XL demonstrate how hard it is to turn around a very strong command-and-control system. Change implies not only changing legislation but also changing organizational structures, expertise, and working routines.

Yet, change is possible. In the Netherlands, over the course of a decade the basic policy approach has been changed quite fundamentally. Through the late 1980s, the Dutch government relied almost exclusively on direct regulation supplemented by some taxes for water pollution. Today the target group policy, with its emphasis on collaboration and negotiation, stands central. In the Netherlands, the government was able to draw on the strong neo-corporatist traits of the Dutch society when changing the core features of its policy system. Both representatives of industry and governmental actors were willing to look for a way out of the traditional regulatory system, although for different reasons. Without a broader context of collaboration and both parties willing to work towards an alternative system, this change would have been very difficult.

The key lesson is not that all countries should follow the Dutch example, which may not fit the more adversarial culture of countries like United States, and which has been evaluated as having both strengths and weaknesses. Rather, the evaluations from this workshop point toward the need for a careful examination of the ways in which any policy innovation can either work within or change the existing regulatory structure. Notwithstanding the potential advantages of Voluntary, Collaborative, and Information-Based approaches, these cannot be effective unless designed to work synergistically with the larger policy system. In some cases this will require legislative changes; in others a carefully design package of programs and policies that can build capability and provide incentives for action.

Long-term commitments vs. flexibility
One of the benefits of voluntary, collaborative, and information programs is that they may turn the attention of both governments and business to longer-term strategies. As reported in the previous sections, this creates a dilemma concerning flexibility, especially in cases where programs result in legally binding agreements between governments and industry. Future insights into the cause and nature of environmental degradation will lead to a need for new policy developments. As industry partners with government and other stakeholders in setting ambitious environmental goals, firms are looking in turn for some assurances that these goals will not change in mid-stream. Although this is understandable and perhaps even necessary, governments will feel the need and obligation to respond to evolving knowledge about environmental hazards. The dilemma between long-term planning and flexibility still needs to be addressed.

Transaction costs
High transaction costs is a critique that was aimed at nearly all of the programs that were examined in this workshop and for these approaches more generally. It was beyond the capability the workshop to quantify these costs. It was also not possible to place them in any kind of cost-benefit scheme. Do the successes noted in many of the programs justify their high costs? Were the transaction costs of these programs higher than those of reaching the same goals through other regulatory approaches? These questions need to be addressed, as it is important to consider the efficiency as well as the efficacy of these programs.

Evaluation
In order to identify effective policies, the new approaches should be designed with a plan for evaluation. Evaluation can be challenging, as we often need to answer the "what if" questions, i.e. try to compare results from the new policy with what would have happened without it. Nonetheless, this type of analysis is critical if we want to learn through experimentation. Thus, more attention should be given to evaluation, including making evaluation an integral part of program design, collecting the necessary data, and putting the funding for evaluation into the budget of new programs. At this point, we often have process-oriented data for evaluation, when what we really need is to evaluate the impact on the environment. It is essential to look beyond process variables (i.e. how many firms adopted EMS) and evaluate actions taken to reduce environmental impacts as well as the actual reduction of environmental impacts.

The Prospects for Voluntary, Collaborative and Information Strategies

In this report we have tried to capture the strengths and weaknesses of Voluntary, Collaborative, and Information-Based approaches in environmental policy. Taken as a whole, the programs examined in this workshop have more successes than failures. To make this judgment, of course, one has to hold out a standard for evaluation. Complete failure is fairly easy to identify, and lessons have been drawn from the failures presented at the workshop. Defining success is more challenging. At this point, we are in a situation where one might argue that the glass is either half-full or half-empty. The glass is half-full, as many of these programs have already improved the environment, a well as

establishing long-term goals that hold up the prospect for more fundamental change in the future. The glass is half empty if we judge the current achievements of these programs against the huge challenges posed at the beginning of this workshop. Simply put, radical technological innovation or private sector leadership is needed for an industrial transformation for sustainable development. While the programs have contributed to technology innovation, it was more often incremental than radical. While there is evidence of private sector leadership and beyond compliance behavior, there is concern that it may be one-off rather than on-going, and focused on near-term opportunities rather than longer-term and more difficult targets.

From the evidence presented and discussed during the workshop, we conclude that synergistically employing multiple approaches will be our best shot of guiding industry on the path towards sustainable development. Voluntary, collaborative, and information programs can play a useful role in such a comprehensive strategy but only if they are carefully designed to fit with and complement the other elements of a nation's environmental policy system. In the end, the real question therefore is not whether the new approaches should be used, but rather *how* they should be used. Voluntary, collaborative, and information strategies can create capacity, transparency, and flexibility; facilitate the development of long-term agendas; provide opportunities and incentives for firms to assume leadership in environmental protection; and provide avenues for greater community and NGO participation. As demonstrated by the cases in this chapter, these new approaches can be effectively targeted toward capacity building or toward actual improvements in environmental performance. They can also be targeted toward either individual firms, in an effort to create leaders, or toward an entire industry sector, in an effort to bring forward all firms. Regardless of goals, there will remain a role for direct regulations and market-based approaches as part of an overall strategy - they will be needed to create sufficient pressures to push industry along the path toward sustainability.

APPENDIX A: WORKSHOP ORGANIZERS

Energy Technology Innovation Project
Belfer Center for Science & International Affairs, Harvard University
The Energy Technology Innovation Project (ETIP) at the Belfer Center for Science and International Affairs is a joint project of the Science and Technology Policy Program and the Energy and Natural Resources Program. Our focus is on crafting and catalyzing a set of policies and institutions that can stimulate the research, development, and deployment of energy technologies that can address the full range energy-related challenges of the 21st century, including environment, development and security issues. ETIP has ongoing research in two areas: (1) Energy Technology Policy for a Greenhouse-Gas Constrained World and (2) Technology Innovation Studies. In the first area, we are currently focused on the U.S., China, and India, with a strong emphasis on the role of international cooperation in the development and deployment of cleaner energy systems. In the second area, we examine how government policy and programs can play an effective role in stimulating private sector investments in the development and deployment of cleaner energy technologies.

Regulatory Policy Program
Center for Business and Government, Harvard University
The Regulatory Policy Program (RPP) at the Center for Business and Government provides an environment in which to develop and test leading ideas on regulation and regulatory institutions. RPP's research aims to improve the global society and economy by understanding the impacts of regulation and creating better decisions about the design and implementation of regulatory strategies. Research is organized around the three core areas: regulation, markets, and deregulation; regulatory instruments; and regulatory institutions and policymaking. The aim throughout is to ask the big questions about when regulation works, and about what kinds of regulatory instruments and institutions are best for the economy and society in an increasingly globalized world. The program seeks to develop a better understanding of where the field of regulation has traversed for the past several decades and, most significantly, where it is headed in this new century.

Center for Clean Technology and Environmental Policy, University of Twente
The Center for Clean Technology and Environmental Policy (CSTM) is the interfaculty institute for environmental studies at the University of Twente. The research, educational and advisory activities of the CSTM aim at the development of new strategies for public policy, technology and management as conditions for a responsible environmental protection. The CSTM operates on the basis of a research program entitled "Conditions for responsible environmental protection." The central research question of this program reads: how can conditions for responsible environmental protection be optimized in the form of constraints for social, economic and industrial processes, and what is the position of government policy in this context? The research program comprises three themes: 1) Conditions for responsible environmental management by social actors: optimalization through technology and management. 2) Controlling conditions for responsible environmental management: the organization and dynamics of public policy. 3) Administrative capacity for responsible environmental management: establishing cooperation between administrative levels.

APPENDIX B: WORKSHOP AGENDA

Belfer Center for Science and International Affairs, Harvard University,
Center for Business and Government, Harvard University, and
Center for Clean Technology and Environmental Policy, University of Twente

present

Voluntary, Collaborative, and Information-Based Policies:
Lessons and Next Steps for Environmental and Energy Policy
in the United States and Europe

Sponsored by:

Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

May 10-11, 2001

Thursday, May 10, 2001
Taubman Building, 5th Floor, Room AB

8:15 AM – 8:45 AM Continental breakfast

8:45 AM – 9:15 AM Welcome and Introduction — John Holdren and Vicki Norberg-Bohm, *Harvard University*

Session 1: **Voluntary Approaches**
Chair: Kurt Fischer, *Clark University*

9:15 AM – 10:15 AM Panel 1.1: authors

- "Energy Star" — Bruce Paton, *UC Santa Cruz*
- "Promoting Environmental Management in Dutch SMEs" — Theo de Bruijn and Kris Lulofs, *University of Twente*
- "Project XL" — Alfred Marcus, *University of Minnesota*

10:15 AM – 10:30 AM **Break**

10:30 AM – 11:30 AM Panel 1.2: discussants

- Skip Laitner, *US EPA* (for Paton)
- Tim Jenkins, *Friends of the Earth, UK* (for De Bruijn and Lulofs)
- Shelly Metzenbaum, *Performance Management Project* (for Marcus)
- Leslie Carothers, United Technologies Corporation

11:30 - 12:00 Discussion

12:00 PM – 1:00 PM **Lunch**

Session 2: **Industry Sector Collaboration**
Chair: Henry Lee, Harvard University

1:00 PM – 2:00 PM Panel 2.1: authors

- "Common Sense Initiative"— Cary Coglianese, *Harvard University* and Laurie K. Allen, *National Marine Fisheries Service*
- "Dutch Target Group Negotiations"— Peter Hofman and Geerten Schrama, *University of Twente*
- "The End-of-Life-Vehicles Program in Germany" — Helge Jörgens and Per-Olof Busch, *Free University of Berlin*

2:00 PM – 2:45 PM Panel 2.2: discussants

- Daryl Banks, CH2M Hill, USA (for Coglianese)
- Marilyn Brown, *Oak Ridge National Laboratory, USA* (for Hofman and Schrama; and Jörgens and Busch)
- Dan Fiorino, *U.S. EPA*

2:45 PM - 3:15 PM Discussion

3:15 PM – 3:30PM **Break**

Session 3: **Collaborative Approaches for Technology Development**
Chair: Robert Frosch, Harvard University

3:30 PM – 4:10 PM Panel 3.1 authors

- "R&D Collaboratives"— Vicki Norberg-Bohm and Robert Margolis, *Harvard University*
- "Danish Cleaner Technology Action Plans"— Ulrik Jørgensen, *Technical University of Denmark*

4:10 PM- 5:00 PM Panel 3.2: discussants

- Jerry Rogers, *GM, USA* (for Norberg-Bohm)
- Nils Thorsen, *Ernst & Young, Denmark* (for Jørgensen)

5:00 PM - 5:30 PM Discussion

5:30 PM Adjourn

6:30 PM– 8:30 PM **Dinner—Legal Seafoods, Cambridge, MA**

Friday, May 11, 2001
Taubman Building, 5th Floor, Room ABC

8:00 AM – 8:30 AM Continental Breakfast

Session 4: **Information Disclosure Policies**
Chair: Ira Jackson, *Harvard University*

8:30 AM – 9:10 AM Panel 4.1: authors

- "Toxics Release Inventory (TRI)" — Mary Graham, *Harvard University* and Catherine Miller, *Hampshire Research Institute*
- "Environmental Disclosure in Norway — Audun Ruud, *University of Oslo*

9:10 AM – 10:00 AM Panel 4.2: discussants

- Mark Greenwood, *Ropes and Gray, USA* (for Graham)
- Rolf Marstrander, *Norsk Hydro, Norway* (for Ruud)
- Bob Massie, *CERES, USA*

10:00 AM – 10:30 AM Discussion

10:30 AM – 10:50 AM **Break**

Session 5: **Environmental Management Systems**
Andrew Hoffman, Boston University

10:50 AM – 11:30 AM Panel 5.1: authors

- "Star Track" — Jennifer Nash, *Harvard University*
- "EMAS in Europe" — Andrew Gouldson, *London School of Economics*

11:30 AM – 12:10 PM Panel 5.2: discussants

- John Harris, *Ashland Inc., USA* (for Nash)
- Martin Baxter, *Institute of Environmental Management and Assessment*, UK (for Gouldson)
- Dan Fiorino, *U.S. EPA*

12:10 PM – 12:30 PM Discussion

12:30 PM – 1:30 PM **Lunch**

1:30 PM – 2:30 PM Conclusion: Discussion of directions for policy
Chair: Theo de Bruijn, *University of Twente*

2:30 PM Adjourn

APPENDIX C: PAPER ABSTRACTS

Converging and Separating Mechanism in Voluntary Product Labeling Programs
Bruce Paton

Energy STAR targets voluntary improvements in product energy-efficiency. Initiated by the EPA in 1992, the Clinton Administration expanded the Energy STAR program to include several projects administered by the DOE. The Energy STAR family now includes office equipment, office buildings, residential buildings, computers, and transformers. Firms participating in the Energy STAR programs gain the right to use the program's logo to differentiate their energy-efficient products from less efficient competitors. EPA publicizes the cooperative efforts of industry groups, creates awards to recognize superior efforts by individual firms, and conducts media campaigns to raise public awareness of the Energy STAR program. The Energy STAR program is designed to intervene on both the supply and demand sides of the market. The program influences supply by encouraging manufacturers to produce energy-efficient equipment. The program influences demand by providing large customers with a simple criterion for specifying energy-efficient equipment.

This paper examined two Energy STAR products: washing machines and computers. Both the washing machine and the computer programs have resulted in significant energy savings and have spurred technology innovation, but in varying degrees. In both cases, Energy STAR's voluntary approach was used in tandem with other policies, suggesting that voluntary labeling can be most effective as a complement to other environmental policy instruments.

The Energy STAR Washing Machines Program has seen dramatic innovations in product and process technology, driven by intense pressure for firms with strong brand names to differentiate their products. Only the high-end consumers are currently adopting these more efficient machines, creating a two-tier market. However, based on these innovations, the industry and the Department of Energy negotiated new energy efficiency standards for washing machines, which have now been put into law and which will bring these innovations to the majority of the market.

The Office Products program has created little incentive for firms to innovate in ways that differentiate their products based on improved energy consumption. The great majority of firms have adopted a single approach, based on components provided by a single manufacturer, Intel. This reflects, in part, Intel's dominant role in the industry, but it may also reflect the lack of opportunity to differentiate products based on energy efficiency. Federal procurement policy specifying that only Energy STAR computers would be purchased, as well as EPA's efforts to convince large private sector firms to purchase only energy star computers created an incentive for all manufacturers to produce only Energy STAR computers.

Based on these cases, two different approaches for voluntary labeling programs are identified— converging and separating mechanisms. Converging mechanisms, such as

Energy STAR Computers, change the behavior of an entire industry simultaneously. They achieve at least modest results relatively quickly, and provide a process for continually ratcheting industry performance upward. For success, firms need a compelling reason to cooperate, such as a threat of regulations or procurement policies that would keep non-participants out of the market. The potential weakness of converging mechanisms is that they can produce least common denominator results, it may be difficult to move to more stringent requirements after the initial agreement, and they may be less ambitious than regulations.

Separating mechanisms reward the behavior of leading firms with the hope of motivating others to follow. Separating mechanisms create awareness among both manufacturers and consumers of the improvements that are possible. By accelerating innovation, they increase the range of options for manufacturers to increase energy efficiency or environmental performance. Properly designed, they also create pressure on lagging firms to catch up with the leaders. Over time, the result made be similar to a converging mechanism in leading an entire industry to improved energy efficiency. Potential weaknesses are a limited influence on firms that cannot qualify, and an inability to prevent lower quality products from entering a market.

The Dutch Policy Program on Environmental Management: Policy Implementation in Networks
Theo de Bruijn and Kris Lulofs

Shared responsibility, as advocated by the European Union, has become a central perspective in Dutch environmental policy. Basically, it recognizes that single actors, be they governments, industry, NGOs and the general public, do not have the capacity to bring about the changes needed for sustainable development on their own. Collaborations and interaction are therefore key-elements in today's Dutch environmental policy. The policy program on environmental management is an example of this new policy approach. The central concept underlying this program, which promotes the adoption of environmental management is to stimulate the companies' own responsibility and initiative, thus improving the responsiveness, capacity and capability of industry.

In 1989, the Ministry of the Environment in the Netherlands published the Memorandum on Environmental Management. The objective of this Memorandum was to have companies introduce an environmental management system by 1995. It was, however, a voluntary program. No sanctions were set in the short run for companies who wouldn't implement management systems, other than stating that they might be subject to more and severe enforcement. The basic philosophy was to convince companies of the usefulness of environmental management by explaining its central concepts and offering concrete support during implementation. At the same time, an ambitious agenda for environmental change was implemented through the National Environmental Policy Plan and subsequent the target-group policy. Adapting environmental values and the implementation of environmental management systems in SMEs were thought to be important steps in the transformation process towards sustainable companies. The program can be seen as tool to increase the commitment of industry and to institutionalize

environmental management systems and environmental management. Although the program also aimed to direct environmental impacts, the general idea was to generate mutual trust for government-industry collaboration, to enhance capacity building within industry, to involve third parties and to build networks. From the start this trajectory was planned as a long-term strategy without very articulated goals at its initiation, and therefore open to policy learning. Where the target-group policy basically specified the standards that needed to be met by industry, the policy program on environmental management aimed at showing companies how they could reach for those kind of standards.

In the memorandum a distinction was made between the (few) larger companies and the main group of SMEs. Instead of dealing with SMEs directly, the Dutch government tried to facilitate and manage the formation of networks in which intermediary organizations were expected to act as agents for change. Policy implementation therefore took place in two distinct phases. In phase one the ministry stimulated intermediary organizations to translate the concept of environmental management into concrete actions for specific target groups. In phase two companies were expected to implement these actions into their daily management practices (with the help of intermediary organizations) in order to establish environmental management systems.

We find the program to be relatively successful. Our data show that real networks have been built over the years. The partners in those networks are also delivering meaningful input to individual companies. Our evaluation does suggest, however, that some of the existing nodes within the network were quite effective (most notably the trade associations) while new nodes were not. This suggests that programs may be most successful if they are implemented through existing institutions that have compatible objectives and capabilities. Although our main conclusion is positive concerning the effectiveness of the network approach, we conclude at the same time that the context in which the policy program has been implemented, and especially the close connection with other more regulatory paths and the target-group policy, has been a crucial factor in this.

Cooperative Regulation: Setbacks and Accomplishments of Project XL
Alfred Marcus

Governments, businesses, public interest groups, affected communities, and academics are searching for new and innovative ways to achieve common environmental goals. They are striving to find approaches and techniques that provide “cleaner, cheaper, and smarter” solutions to environmental problems. The Environmental Protection Agency’s (EPA’s) Project XL (eXcellence and Leadership) has been one of the most ambitious and potentially consequential of these experiments. As conceived, Project XL was a centerpiece of the Clinton administration's effort to develop alternatives to the existing regulatory system. Under project XL, the EPA could enter into partnerships with the full range of stakeholders - businesses, environmentalists, states and communities - to develop and test alternative strategies for single facilities, industrial sectors, or geographic areas.

The expected benefits of Project XL included:

(1) increased flexibility to adopt innovative solutions to environmental problems,
(2) increased and more cost-effective environmental protection,
(3) improved compliance and increased use of innovative technologies,
(4) expanded use of waste minimization and pollution prevention strategies, and
(5) a more cooperative relationship between regulators, the facility, and the community.

The government would establish a high bar of environmental performance for excellent companies and they would be given the flexibility to decide how they were going to jump over it. The Clinton administration envisioned a quid pro quo, in which regulated businesses would be granted greater regulatory flexibility in return for achieving superior environmental performance.

3M's world-class tape manufacturing facility in Hutchinson, Minnesota was one of the first facilities that stepped forward to negotiate a permit under the auspices of Project XL. The purpose of the 3M pilot was to obtain a permit that incorporated many of the features of a new approach to environmental management, including: superior environmental performance, flexible, facility-wide performance-based environmental goals, pollution prevention, an innovative environmental management system, reduction in compliance and enforcement costs, and explicit measures to ensure accountability. The agreement was to have been forged with community stakeholder and interested party participation, and the overarching aim was to achieve better environmental results than could have been achieved under existing requirements. Nevertheless, rather than getting a pilot project up and running, the negotiations among EPA, 3M, and the Minnesota Pollution Control Agency (MPCA) faltered and broke down.

This chapter compares the substance and process of the proposed 3M project with three XL pilots that were approved - Intel, Weyerhaeuser, and Merck. This discussion focuses on the gap between the rhetoric of reinventing environmental regulation and the reality of implementing changes to the existing system. Substantive differences explain why issues were contentious but not why some pilots were approved and others were not. The key substantive issues are related to disagreements about the definition of superior environmental performance (SEP). The main process difference was the direct involvement of the state government in the 3M pilot, which had no parallel in the other cases. Ultimately, the story of Project XL, as reflected in these 4 cases, reveals the challenges and complexities inherent in attempts to move beyond the familiar paradigm that has shaped U.S. environmental programs and policies for three decades.

Building Sector-Based Consensus: A Review of the U.S. EPA's Common Sense Initiative

Laurie K. Allen and Cary Coglianese

From 1994-1998, the US Environmental Protection Agency (EPA) ran what then-Administrator Carol Browner called a "bold experiment" in regulatory reinvention. It brought together representatives from six industrial sectors and sought to forge a consensus within each sector over innovations in environmental management and policy. This paper examines the impact of EPA's experiment with this sector-based, consensus-building approach, considering the extent to which the EPA's Common Sense Initiative (CSI) achieved its goals of improvements in technological innovation and environmental results.

CSI operated from July 1994 through December 1998, seeking to take advantage of the in-depth knowledge by firms and organizations within specific industrial sectors to develop “cleaner, better, cheaper” approaches to environmental control. Its goals were to overcome the problems of the media-specific, adversarial command-and-control system by fine-tuning environmental regulation to the specific circumstances of different industrial sectors. By bringing together industry, environmental groups, and other interested parties within a sector, the agency sought agreement on new and better ways of achieving environmental performance goals. Under CSI six subcommittees (one for each sector) in which representatives from industry, NGOs, labor unions, and governments were represented, had to make recommendations to an overarching council. The council renewed these, and sent the recommendation it endorsed to EPA for implementation.

How well did this bold experiment work? The tangible results of this innovative initiative have been at best quite modest. CSI clearly had an ambitious vision (Fiorino, 1996) and some within the agency believed it held the potential for much flexibility. But by the end of the 4-year initiative, only about 4 of the approximately 30 subcommittee recommendations that were endorsed by the CSI Council and submitted to EPA for policy change have led to actual revisions in EPA regulations. Moreover, relatively few of the project accomplishments, according to the agency’s own reports, have achieved technological innovations.

CSI’s focus on fine-tuning environmental regulation to the specific circumstances of different industrial sectors may well be a promising strategy for developing more sensible and effective methods of environmental protection. But because this Initiative was pursued under the constraints of consensus as a decision tool, it was destined not to achieve much of immediate significance beyond deepening professional networks and relationships within each industrial sector. CSI’s failure to transform the existing regulatory system stems from the legal constraints imposed on EPA and the inability of consensus-building to overcome those institutional barriers for change.

The chief lesson to be learned from CSI should be that fundamental change in a regulatory system that is governed by a highly detailed set of statutes will not come about

without changing those statutes. Efforts such as CSI may well serve a useful purpose of providing some new ideas for making incremental changes, but we should not expect that consensus-building will provide the route to a fundamentally "cleaner, cheaper, and smarter" regulatory system.

The Dutch Target Group Policy
Peter Hofman and Geerten Schrama

Our understanding of environmental problems and of ways to address them has increased in the last decades. However, while some of these environmental problems have become increasingly evident and more pressing there are no ready-made solutions to these problems. In the search for more effective and efficient environmental policies, approaches have shifted from direct regulation with strict enforcement, to more flexible and consensual approaches. Much of these new developments are based on the premise that the transition to sustainability requires a co-operative paradigm, with diverse stakeholders negotiating a shared vision of the future and co-ordinating their resources in order to progress towards sustainable development. It also argued that these approaches are more cost effective as target groups can time the development and introduction of new technologies and are not confronted with short-term standards which are likely to be sub-optimal in the long term. The Dutch target group policy is one of the best-known examples of this new environmental policy approach. It was formulated as part of the National Environmental Policy Plan that was introduced in 1989. This chapter evaluates the Dutch target group policy for the industrial sector. In this chapter we focus specifically on how its co-operative and long-term character has influenced processes of innovation and diffusion in industrial branches.

The introduction of the first NEPP in 1989 was part of a deliberate attempt to change the philosophy of environmental policy in the Netherlands and to reach for shared responsibility. Care for the environment should no longer be the exclusive responsibility of government, but social actors should become aware of their own contribution to the degradation of the environment and be encouraged to assume responsibility. After the publication of the NEPP in 1989 the implementation took place through the establishment of negotiated agreements with industrial branches. The outcomes of the negotiations were written into a negotiated agreement, that was signed by all parties involved in the negotiations, the branch associations, some of the larger companies, the ministries involved, and also representatives of the regulators (provinces, municipalities, and waterboards). The so-called covenants would not replace environmental laws but would set a planning cycle and framework for companies to implement the NEPP. The targets in the covenants were often considered as rather demanding, but part of the deal was that the sector was assured that during the 'contract period' no new demands would be imposed by new legislative measures, and that the environmental permits of individual participating companies would be adjusted to the content of the agreement.

The diffusion of the state of the art of technology as propagated in negotiated agreements seems rather successful until now. It is, however, highly dependent on direct regulation in forcing laggards to adopt new technologies. This implies that when direct regulation

fails, negotiated agreements are also likely to fail. In order to development 'new' technologies the negotiated agreements are complemented by programs which specifically inform the target group about, and focus on, technological paths and technologies which need to be developed in order to solve technological bottlenecks.

However, it is still unclear whether this will result in more radical technological innovation in the longer term. One advantage of the target-group policy is that industry can time the development and implementation of product and process changes to coincide with investment cycles. Another positive attribute is that in the process of eliminating bottlenecks to significant improvement and of searching for new technological options, actors are more likely to engage ideas from other actors and discover the potential for collaboration. One concern is that the consensual nature of negotiated agreements and the network of actors currently involved in the agreements promote innovations of an incremental nature rather than radical innovations. This is in part because of the inclusion of near-term goals in permits and in part because newcomers, or new technologies which might be developed outside the branch, are not part of the negotiated agreement. More research is needed on whether the consensual and target group approach is conducive to radical innovation.

The Voluntary Pledge Regarding the Environmentally Sound Management of End-of-Life Vehicles in Germany
Helge Jörgens and Per-Olof Busch

The disposal of end-of-life vehicles (ELV) became an important environmental issue in Germany in the late 1980s. First national goals in the area of ELV-management were set in 1991 by the German government. This was the starting point of an intensive debate on regulatory measures for the reorganisation of the national system of ELV-management. In 1992 and again in 1994 draft ordinances regarding the disposal of ELV were developed by the *Ministry for the Environment* (BMU) and discussed with the relevant actors. In February 1996, after lengthy informal negotiations and the repeated threat of passing an *ELV-Ordinance*, 16 branch organisations of the automotive, recycling and supply sector submitted the *Voluntary Pledge Regarding the Environmentally Sound Management of End-Of-Life Vehicles (Passenger Cars) Within the Framework of the Closed Substance Cycle and Waste Management Act* which was informally accepted by the BMU. The main goals of the VA on the environmentally sound management of ELVs are:

- the recycling oriented design of cars and their components,
- the environmentally sound treatment of ELVs, especially with regard to the removal of operating fluids and the dismantling of vehicles, and
- the development and optimization of closed material cycles and facilities for recovery.

As a reaction to the voluntary pledge, the German government refrained from a comprehensive regulation, but presented a 'lean ordinance' to supplement the voluntary solution. The *ELV-Ordinance* was adopted by parliament in June 1997. It regulates the

process of ELV management and the relationship between ELV owners, operators of return stations, dismantlers, and shredders. It aims to guarantee the effective implementation of the VA and to ensure the competitive structure of the ELV-management market (Bundesregierung, 1996). Both, the voluntary agreement (VA) and the parallel *ELV-Ordinance* came into force in April 1998.

Less than three years after its enactment, it is still too early for a comprehensive and conclusive evaluation of the performance of the VA and a thorough assessment of its environmental impact. A few observations can be made however. From an environmental point of view the combination of the VA and the *ELV-Ordinance* differentiates in an appropriate manner between the immediate and the long-term solutions of the environmental problems related to ELV management. The policy approach first concentrates on the most relevant or urgent problems by pursuing a regulatory end-of-pipe policy and then pursues in a long term perspective a preventive policy corresponding with the principle of producer responsibility aimed at improving the recycling oriented design of cars. In practice, the general concept of the new measures is aimed at the environmentally sound recovery and disposal of ELV rather than at the avoidance or minimisation of potentially hazardous waste. Generally, it can be argued that the major responsibility for reaching the more immediate goals and costs are carried by dismantlers and shredders. The combination of the VA and the *ELV-Ordinance* leaves a great leeway for automobile producers and importers as to the concrete measures for reaching their goals, but introduces rather strict, detailed and cost-intensive regulations for dismantlers and return stations.

Taking into account the current lack of a sufficiently large market for recycled materials and the weakness of price incentives for the automobile producers to design recycling oriented cars, it has to be questioned if voluntary measures in this area will be sufficient. Nevertheless the cooperative ties between the different actors in the ELV chain, especially between the automotive industry and the dismantling companies, that resulted from the VA might contribute to an intensive information exchange, which could also contribute to innovations and improvements in the recycling-oriented design of cars. The introduction of a cost-free take-back of all ELVs through the recently adopted European ELV Directive could certainly help to strengthen producer responsibility and thereby lead to a greater involvement of the automotive industry in the process of ELV management.

Reaching Environmental Goals through R&D Collaboration: Lessons from the U.S. Department Of Energy Programs for Gas Turbines and Solar Photovoltaics
Vicki Norberg-Bohm and Robert M. Margolis

In the United States, sectoral efforts to achieve environmental goals have often been R&D programs rather than regulatory programs. This paper focuses on three R&D collaborations in the power sector: the Advanced Turbine Systems (ATS) program, the Photovoltaic Manufacturing Technology (PVMaT) project, and the Thin-Film PV Partnership project. This paper analyzes the effectiveness of these R&D collaborations in reaching environmental and technological goals by examining the role that collaboration has played in both goal setting and implementation. We conclude that collaborative goal

setting has provided non-regulatory incentives for beyond-compliance environmental performance, and that collaboration in implementing the R&D programs has contributed to successful technology development.

Collaborative planning processes can provide the opportunity to establish "stretch" goals, i.e. technological goals with environmental benefits that are beyond what is required by regulation and what the private sector would pursue on its own. The R&D collaborations examined in this paper have resulted in: (1) "stretch" goals for efficiency and a pollution prevention approach to NOx control for gas turbines, (2) proactive approaches to limiting environmental impacts in PV cell manufacture, and (3) better decisions about the allocation of R&D resources.

Collaboration in implementation contributed to success by both spreading risk and reducing risk. This was done through several program elements, including cost-sharing as well as a variety of collaborations between industry, universities, and national laboratories. These three cases suggest that the role that should be played by each partner depends on the technological and organizational capabilities that they can bring the table, and this may vary considerably from one industry or technology to another. Having said that, some cross-cutting institutional lessons suggested by these cases are: (1) the private-sector partner should base their program in their business unit, and not in their R&D laboratory, (2) universities should be engaged on industry-defined research agendas, and focused on riskier, longer-term and/or pre-competitive technologies, (3) the national laboratories should be involved based on the specific complementary physical and/or human assets they can contribute to the collaboration, (4) industry-industry collaboration will be fostered when the program sets goals that require collaboration for success.

In sum, through goal setting and implementation, these collaborations moved industry at a faster pace than it would have otherwise gone. For both gas turbines and PV, this resulted in having better products available for the rapidly expanding market at the turn of the century. In order to stimulate technology development that stretches industry beyond what it would have done without the program, government needed to provide significant cost-sharing, and industry had to believe that the goals were reachable and that the resulting technology would be competitive in the market. In this sense, these programs operated in tandem with energy and environmental regulation that was creating markets for these technologies, both at home and abroad.

These programs were focused on near- and medium-term technological goals, and as such have contributed to improved environmental performance in the power sector. In considering the application of R&D collaborations for long-term sustainability, three additional issues must be addressed: balancing near-term and long-term technological goals, integrating evolving environmental science and regulation into project goals, and ownership of intellectual property rights.

Cleaner Technology in Denmark- Support Measures and Regulatory Efforts
Ulrik Jørgensen

The Danish government support programs for cleaner technology innovations and demonstrations were initiated in 1987. They were viewed as a supplement to traditional environmental protection measures, mainly to overcome some of the problems with direct regulation. The Development Program for Cleaner Technology was introduced and managed by the Danish Environmental Protection Agency (DEPA). The aim of this program was *to reduce the strain on the environment through preventive efforts with the aid of improved incentives to employ cleaner technology* (DEPA 1986, p.27). This program was followed by a continued series of action plans. The second ran from 1990 to 1992, the third from 1993 to 1997, and these were followed by a new program that continued until the late 1990's.

These programs offered in principle four different types of grants to applicants from industry, consultancy and R&D institutions: (1) to develop (innovate) new technological solution for industrial use; (2) to survey branches of industries for information on the potential and use of cleaner technologies; (3) to implement cleaner technologies in full scale production and document the result; and (4) to establish demonstration facilities showing the working and the results from implemented cleaner technologies. While the two first types of projects could receive almost full government funding, the latter two could only receive grants for the portion of the project, that could not be identified as standard production investments in the companies involved, for example the extra costs for documentation and information/demonstration.

At a general level the strategy of having industry and R&D institutions involved on a voluntary basis in developing cleaner technology solutions has shown to be very successful. Out of 169 projects funded in the period from 1987 to 1992, 71% have led to useful technology options and of these 50% were implemented successfully in full-scale production. Similar data have been collected for projects funded by the later action plans.

The Danish collaborative approach to technology innovation and diffusion has had a measurable and significant impact on the availability of cleaner technologies. However, the diffusion and implementation of these technologies, while significant, has not reached its full potential. For example, in the area of volatile organic compounds, an environmental problem given high-priority in the initial program, only 25 to 40 percent of potential reductions in pollution have been achieved. The basic difficulty here is that local authorities, which provide facility permits and have significant discretion in the Danish environmental policy system, have either not built adequate knowledge from the clean technology programs or have not implemented the available clean technologies in their negotiations with industry over permit levels. Two regimes seem to co-exist without clear linkages between them. On the one hand there is the government centered command and control; on the other the voluntary and market based technology innovations. The combination of these systems and the integration of a coherent set of regulatory practices have not emerged from the 15 years of experience. In fact, there appears to be a dead lock. In sum, the cleaner technology programs have not succeeded

in fundamentally penetrating and changing the traditional command-and-control approach to environmental regulation.

Disclosure of Toxic Releases in the United States
Mary Graham and Catherine Miller

Under a 1986 federal law, some categories of manufacturers in the United States are required to disclose to the public their releases of certain toxic chemicals, facility by facility and chemical by chemical. Releases must be reported annually in standardized formats. This Toxic Release Inventory (TRI) differed from existing national regulation of toxic chemicals in its emphasis on lawful releases of chemicals and in its multi-media approach. During the 1990s, the federal Environmental Protection Agency expanded substantially both the chemicals for which reporting is required and the manufacturers required to report. Although the TRI was created as a modest "right-to-know" provision, the public disclosure it required came to be seen as an effective means of reducing toxic pollution. By 1998, it was credited with contributing to a 45 percent reduction in releases of listed chemicals.

Behind this often-quoted decline, however, lies a more complicated story. Releases declined at a much more rapid rate in early years than later, with half of the total decrease registered in the first three years. Relatively few facilities cut releases by reducing waste at the source, the preferred method under national policy, but recycling increased substantially and releases of carcinogens have declined at a somewhat faster rate general public in standard formats, at regular intervals, by facility and by chemical for all types of environmental releases made it possible for people to compare companies and track changes over time. At the same time, because it targeted only releases of manufacturers, the TRI had no effect on the nation's largest sources of toxic pollution: cars, trucks and buses and small businesses. Because it did not require reporting of chemical use (as opposed to release), it created no incentives to reduce waste at the source. Because it lacked a metric that calibrated risk, there was no assurance that reduction in releases equated to reduction in risk. Also, the TRI's design placed important limitations on the timeliness and accuracy of data.

Structured disclosure is emerging as an important tool of risk regulation in the United States. Under our system of government, the development of new regulatory policies is inevitably incremental. The TRI provides early and valuable lessons about the role of disclosure as part of a complex web of changing political and economic forces that influence corporate decisions. Understanding the story behind the general decrease in toxic releases during the last decade and appreciating the influence of TRI's architecture on industry incentives will assist designers of future systems. In addition, the growing power of computers and the Internet offers particular hope for improving the effectiveness of such information-based regulation. They create the potential to bring specific trends in toxic pollution to the attention of interested members of the public and to provide each individual with the customized information that is most useful to them. They also create the potential for combining data from many sources in ways that overcome some architectural limitations and provide improving indicators of risk. Such

progress should not be taken for granted, however. Disclosure systems, like other forms of regulation, can be manipulated to serve narrow political purposes, outdistanced by technology and markets and stymied by unintended consequences. Long-term improvements may depend heavily on the continuing presence of influential constituencies with a strong interest in improving the effectiveness of structured disclosure as a means of reducing risks.

Corporate Environmental Disclosures in Norway
Audun Ruun

Norway has a long tradition of environmental disclosure. The Pollution Control Act of 1981 requires an annual environmental disclosure that forms the basis of the Norwegian Pollutant Release and Transfer Register (PRTR). The Norwegian Accounting Act (NAA) of 1998 expands this practice dramatically. The NAA goes beyond the requirements for reporting on plant specific pollution control, which forms the basis for the PRTR, by requiring firms to report on the life cycle environmental impacts of their products. In essence this means that firms have to report on inputs, releases and risks, both for the production process and for their products. It is demanding that the Board of Directors of all commercial firms subject to external auditing requirements discloses specified environmental data that may cause – according to the legislation – "a not insignificant impact on the external environment." The intention of this disclosure as part of the financial reporting is to extend the reporting from plant specific pollution control - to the life cycle of the products that are produced by the particular firm. The Accounting Act differs in three essential ways from the existing environmental disclosure requirements. First, even firms that are not directly involved in hazardous production activities – and thus previously did not have to report to the PRTR – are asked to produce an environmental report. Second, it asks for information on material flows instead of only releases. Third, it demands a lifecycle perspective.

The requested statement from the Board of Directors as part of the annual report is related to a variety of issues:

- type and quantity of energy and raw materials consumed
- type and quantity of discharges and emissions, also including noise, dust and vibrations
- type and quantity of waste generated and deposited and the character of disposal sites and actual or potential contamination or run-offs.
- the risk of accident caused by current activities of the firm
- environmental loads cause by transportation of production input and output

Furthermore for those firms that are manufacturing final goods, the regulation is also asking for a disclosure of the following concerns:

- type and quantity of hazardous chemicals included in the products
- type and quantity of waste caused by the disposal of products
- the environmental load due to use of products, including necessary access to other products such as fuel for automobiles

The NAA explicitly states that the report should include the environmental ambitions and objectives as well as expectations from concerned external parties like governments, customers, suppliers and NGOs.

This paper examines whether the financial legislation is making a difference for corporate environmental disclosures. Few final conclusions can be drawn yet. A report assessing the NAA's first year of implementation (1999) drew the conclusion that few firms were complying with the act. A majority of Norwegian firms did not disclose environmental information in their annual financial report. Some 40% did produce a separate environmental report however, therefore disclosing in a different manner than required by the NAA. Less than 4% fully complied with all the (procedural and substantive) requirements of the NAA.

The paper also presents the 1999 environmental disclosures from two quite different firms that both were considered to be among the best in Norway. The telecommunication corporation Telenor produced an environmental report that seems to respond to the requirements defined in the financial legislation. Sør Norge Aluminium (Søral) has produced a solid environmental report but does not disclose all environmental data that may cause "a not insignificant impact on the external environment" along the life cycle of the primary aluminum. The requirements in the Accounting Act therefore prove to be a tall order for firms, even for the front-runners.

Tiered Environmental Regulation: Lessons from the StarTrack Program
Jennifer Nash

Critics of environmental policy argue that the existing system does little to encourage firms to strive beyond compliance with environmental regulations. It punishes the bad, but fails to motivate the good. This shortcoming is particularly significant given that many environmental problems lie beyond the scope of existing environmental regulations. Many firms are capable of doing more than merely complying with environmental laws, which are written for the general case. Environmental policy should find ways to make superior performance attractive to those businesses that are capable of achieving it.

Tiered systems of environmental regulation are a new approach agencies have developed to encourage companies to strive toward higher levels of environmental protection. Under a tiered approach, regulators invite facilities to institute programs that go beyond regulatory requirements in return for a range of benefits including increased flexibility in meeting environmental standards. Tiered systems have been adopted in 12 states and by the U.S. Environmental Protection Agency (EPA).

The question addressed in paper is whether tiered regulatory systems are likely to lead managers to achieve higher levels of environmental protection than they would otherwise choose. To answer this question, I draw on the experience of the StarTrack program, a pilot program that created a special regulatory track for facilities with strong

environmental performance. The program was run by EPA's Region I (New England) office during the late 1990s.

The paper concludes that StarTrack did little to motivate environmental protection in participating firms. In the view of the private sector managers who took part, the program was mainly a paperwork exercise they undertook to garner EPA recognition of established environmental management practices. StarTrack facilities' environmental performance did improve during their participation in the program, but not as a result of their participation. Facilities that met program entry criteria were managed by people who had already invested in environmental performance improvement, and were committed to continuing to do so. The benefits EPA provided program participants were meager, and less than the agency had promised. As a result, StarTrack attracted only a handful of participants.

StarTrack officially closed its doors in June 2000 when EPA launched its National Environmental Performance Track. EPA considers the Performance Track the "culmination" of a number of reinvention efforts including the Common Sense Initiative, Project XL, the national Environmental Leadership Program, and StarTrack (EPA 2000). The National Environmental Performance Track is based on StarTrack, and shares many of its features. Participation rates are higher, but early indications suggest that the Performance Track may also fall short of motivating higher levels of environmental protection in firms. While the idea of tiered environmental regulation is relatively simple, in practice implementation has raised a complex set of issues. Defining what constitutes strong environmental performance, and how such performance should be rewarded, have proven to be daunting tasks for agencies. Until these issues can be resolved, such programs are likely to result in little tangible benefit.

Voluntary Environmental Regulation and the Imperatives, Incentives and Capacities for Technological Change: The Case of the EU Eco-Audit Regulation (EMAS) in the UK
Andrew Gouldson

Within the context of broader debates about the role of regulation and the scope for regulatory reform, there has been considerable debate on the nature of the relationship between mandatory, voluntary and economic or market based forms of regulation. This paper seeks to contribute to this debate by examining the influence that one framework for voluntary environmental regulation, namely the EU's Eco-Management and Audit Scheme (EMAS), has had on innovation and technological change in the UK. Organisations throughout the EU can choose to register for EMAS if they comply with the various requirements of the scheme and if they wish their environmental management, performance and reporting procedures to be externally verified. In essence then EMAS provides the opportunity for organisations that meet a range of conditions to gain a `seal of approval' that can be usefully both internally within the organisation and externally in the relationship between the organisation and its stakeholders.

Prior to the adoption of EMAS, industry in the UK had been familiar with voluntary management systems based standards for many years. Given the familiarity of UK industry with those kind of standards, and particularly with quality and EMSs in the form of ISO standards, it is perhaps not surprising that the development and application of EMSs in the UK has been relatively rapid. At the time of writing (April 2001), over 2000 organisations in the UK have ISO14001 certification, whilst approximately 120 sites have EMAS registration (ISO World, 2001). In the UK, at least, low participation rates in EMAS appear to have stemmed from a reluctance to seek external validation for existing EMSs and where this has been sought from the perception that EMAS has thus far offered only a limited amount of `value added' over and above that offered by ISO14001.

Although the specific impacts of voluntary regulations such as EMAS are difficult to isolate, the empirical analysis conducted in the UK and presented in this paper suggests that EMAS has helped companies to establish capacities for technological change. However, it also suggests that the extent to which they develop and draw upon these capacities depends upon the wider range of incentives and imperatives that they encounter. Regulations and economic incentives therefore drive the uptake of voluntary initiatives such as EMAS. By helping to establish the capacities for change, voluntary regulations such as EMAS can be seen to complement other command and control regulations and market-based incentives. Indeed, by helping to establish the capacity for change, voluntary regulations such as EMAS may enable governments to impose stricter standards or to establish more challenging incentives and disincentives. This is significant for two main reasons; firstly, it suggests that voluntary regulations that build the capacity for change can have a positive impact but only as part of a wider policy mix that also establishes imperatives and incentives; and secondly, it suggests that positive feedback can exist in the inter-relations between the imperatives, incentives and capacities for change that can create an evolutionary `regulatory space' within which change is particularly achievable. The inter-relations between voluntary, mandatory and economic forms of regulation are therefore of central importance.

APPENDIX D: PARTICIPANT BIOGRAPHY LIST

Voluntary, Collaborative, and Information-Based Policies:
Lessons and Next Steps for Environmental and Energy Policy
in the United States and Europe

MAY 10-11, 2001

LAURIE K. ALLEN
Email: laurie.allen@noaa.gov
Laurie Allen has a B.S. Wildlife and Fisheries Biology from the University of Vermont and an M.P.A. from Harvard's John F. Kennedy School of Government. Her experience at NOAA Fisheries has been primarily related to protected marine resources and fishery conservation, particularly bycatch of protected species in fisheries, under the Federal Endangered Species Act, and the Magnuson Steven Act, the federal marine fishery management statute. Prior to her current position, Allen was the Marine Mammal Program Coordinator for the Northeast Region, NOAA Fisheries, and worked in various capacities as a staff biologist and program manager, providing scientific opinions, policy advice, and program management on marine resource issues. She was one of the primary players in implementing portions of the 1994 amendments to the MMPA on the east coast that required a new stake holder negotiation process.

WILLIAM M. BABIUCH
Email: Bill_Babiuch@nrel.gov
William M. Babiuch is a Senior Analyst at the National Renewable Energy Laboratory (NREL). Dr. Babiuch manages NREL's analysis activities for its customers in the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). He provides direct project management, including close interaction with EERE managers on analysis planning, management of subcontract activities, and management of project resources. Dr. Babiuch has prepared reports and presentations on technology policy, consumer/stakeholder analysis, strategic planning, and energy efficiency and renewable energy programs. Dr. Babiuch holds a Ph.D. in Political Sociology from the University of Notre Dame. He has 12 years experience in environmental, technology, and market analyses and 9 years experience in energy analysis.

DARRYL BANKS
Email: dbanks@CH2M.com
Dr. Banks is a Vice President in the Washington, D.C. office of CH2M HILL, INC. He specializes in strategic corporate environmental management issues; environmental regulatory and technology policy issues; and, energy / climate change issues. Prior to joining CH2M HILL in 1998, Dr. Banks was a Senior Fellow for technology and environmental issues at the World Resources Institute (WRI) for six years. At WRI, he directed and conducted research activities in the following areas: environmental technology policy; innovation and regulatory policy reform; and, strategic corporate environmental management including ground breaking work on environmental accounting. Prior to joining WRI in 1992, he served as Deputy Commissioner for

Environmental Quality at the New York State Department of Environmental Conservation for eight years. In the early 80's he was on the research staff at the Rand Corporation and served in the Office of Research and Development at the U.S. Environmental Protection Agency. A Rhodes Scholar, he holds degrees in biochemistry and chemistry from Oxford University and Coe College. His publications include: "A New Generation of Environmental Technology, " with George Heaton, Investing in Innovation (The MIT Press, 1998); " An Innovation -Driven Environmental Policy," with George Heaton, Issues in Science and Technology, Fall 1995; Green Ledgers: Case Studies in Corporate Environmental Accounting, with D.Ditz and J. Ranganathan, Washington, D.C., (May 1995); and " How to Spur the 'Greening' of Industry in Rapidly Industrializing Countries," Industry and Environment, (July-September 1994).

MARTIN BAXTER

Email: m.baxter@iema.net

Martin Baxter is Operations Manager at the Institute of Environmental Management and Assessment (IEMA), an independent professional body with over 5800 members. Martin is responsible for the professional qualifications and membership standards at the Institute, including training programmes for auditors and environmental managers. Martin is also responsible for the Institute's role as UK Competent Body for the EC Eco-Management and Audit Scheme (EMAS). Martin is an adviser to the UK Government's Department of the Environment, Transport and the Regions on EMAS and ISO 14001. He is responsible for the implementation of EMAS in the UK, including the promotion of the scheme to UK organisations and the development of incentives (both market-led and regulatory) to generate increased participation. He represents the UK on the European EMAS Article 19 Regulatory Committee and sits on the British Standards Institute committee responsible for environmental management systems. Martin is also a member of the United Kingdom Accreditation Service (UKAS) Technical Advisory Committee on Environmental Management Systems.

JAY BENFORADO

Email: benforado.jay@epa.gov

Jay Benforado is the Principal Deputy Associate Administrator for EPA's Office of Policy, Economics and Innovation. His organization is responsible for piloting innovative cross-media environmental strategies, working in creative partnerships with businesses and communities, and assuring that EPA policies and decisions are based on sound economic analysis. He is interested in creating more positive, collaborative relationships with all environmental stakeholders to achieve better environmental results and promote a new ethic of environmental stewardship.

PER-OLOF BUSCH

Email: pelle@zedat.fu-berlin.de

After studying Political Science at the Free University of Berlin (1994-1999), Busch has worked since 1999 as research assistant at the Environmental Policy Research Unit (FFU), Berlin. In his studies he concentrates on the comparative analysis of environmental policy and new environmental policy instruments. Ongoing or completed research projects analyzed conditions for successful voluntary agreements and the

diffusion of environmental policy innovations in OECD-countries and Central and Eastern Europe.

MARILYN BROWN

Email: brownma@ornl.gov

Marilyn Brown is the Director of Oak Ridge National Laboratory's Energy Efficiency and Renewable Energy Program. During her 18 years at ORNL, she has researched the design and impacts of policies and programs aimed at accelerating the development and deployment of sustainable energy technologies. She currently manages a $110 million/year program of research to develop and assess advanced energy efficiency and renewable energy technologies. Prior to coming to ORNL in 1984, she was a tenured Associate Professor in the Department of Geography at the University of Illinois at Urbana-Champaign. In addition to teaching graduate and undergraduate seminars on technological change, resource geography, and multivariate statistical analysis, she received two NSF grants and funding from other sources to support her research on the diffusion of energy innovations. She has a Ph.D. in geography from the Ohio State University where she was a University Fellow, a Masters Degree in resource planning from the University of Massachusetts, and a BA in political science (with a minor in mathematics) from Rutgers University. She has authored more than 140 publications and has received awards for her research from the American Council for an Energy-Efficient Economy, the Association of American Geographers, the Technology Transfer Society, and the Association of Women in Science. Dr. Brown sits on the boards of several energy and environmental organizations and serves on the editorial boards of several journals.

LESLIE CAROTHERS

Email: carothl@corphq.utc.com

Leslie Carothers is Vice President, Environment, Health and Safety at United Technologies Corporation (UTC) in Hartford, with responsibility for environment, health, and safety programs worldwide. UTC is a diversified manufacturer of products for the aerospace and building systems markets. She has been an environmental professional for 29 years. Before joining UTC in July 1991, she served as Commissioner of the Connecticut Department of Environmental Protection from 1987-1991. The Department is responsible for environmental regulation and management of fish and wildlife and parks and forest programs in Connecticut. She also served as Senior Environmental Counsel for PPG Industries, a manufacturing company in Pittsburgh, from 1982-1987 and worked for the federal Environmental Protection Agency for 12 years. She began her tenure in the air pollution program in Washington in 1971 and later served as Enforcement Director and Deputy Regional Administrator of EPA's New England Region in Boston. She is a graduate of Smith College and Harvard Law School and also holds a Masters Degree in environmental law from George Washington University. In 1991, she was an adjunct lecturer on environmental regulation at the Yale School of Forestry and Environmental Studies. She is a member and Chair Emeritus of the Board of Directors of the Connecticut Audubon Society and a member of the Boards of the Nature Conservancy (Connecticut Chapter) and the Environmental Law Institute. She

serves on the Defense Science Board's Task Force on Energy Efficiency of Weapons Platforms whose assignment is to make recommendations to the Department of Defense.

WILLIAM CLARK

Email: william_clark@harvard.edu

William Clark is Harvey Brooks Professor of International Science, Public Policy, and Human Development. He is also a member of the Belfer Center for Science and International Affairs and the University Committee on Environment. Trained as an ecologist, he now works on the linkages between global environmental change and economic development, policy analysis for resource and environmental management, and understanding the use of incomplete scientific knowledge in decision-making. Before joining the school in 1987, Clark led the program on sustainable development of the biosphere at the International Institute for Applied Systems Analysis in Austria. He is co-author of Redesigning Rural Development: A Strategic Perspective and Adaptive Environmental Assessment and Management and co-editor of The Carbon Dioxide Review, Sustainable Development of the Biosphere, The Earth as Transformed by Human Action, Learning to Manage Global Environmental Risks, Our Common Journey: A Transition Toward Sustainability and Environment magazine. Clark is a recipient of a MacArthur Prize and the Kennedy School's Manuel Carballo Teaching Award.

CARY COGLIANESE

Email: cary_cogianese@harvard.edu

Cary Coglianese is Associate Professor of Public Policy at the John F. Kennedy School of Government. His research brings empirical analysis to bear on issues of administrative law and the design of the regulatory process. He is interested in how institutional procedures for judicial review, regulatory analysis, and public participation affect the activities of government agencies. His recent research examines the effect of judicial review on cooperative relationships between federal agencies and outside interest groups, and includes an extensive evaluation of federal agencies' use of negotiated rule making. A member of the American Bar Association and the Environmental Law Institute, Coglianese holds a law degree, master's degree in public policy, and Ph.D. in political science, all from the University of Michigan.

THEO DE BRUIJN

Email: t.j.n.m.debruijn@cstm.utwente.nl

Dr. Theo de Bruijn is a senior research associate of the Center for Clean Technology and Environmental Policy (CSTM) of the University of Twente in the Netherlands. Within CSTM De Bruijn coordinates the research on industrial transformation. He teaches environmental management within several postgraduate courses and for under-graduates. De Bruijn is the European coordinator of the Greening of Industry Network.

JERRY DION

Email: Jerry.Dion@ee.doe.gov

Jerry Dion is Senior Advisor for policy, planning and analysis in Office of Building Technology, State and Community Programs within the Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy. He was lead planning analyst for

the Federal Energy management Program, and planning program manager for the Office of Energy Efficiency and Renewable Energy, prior to his current position. Mr. Dion was the Planning and Policy Program Manager for the Arizona Energy Office prior to his employment at the Department of Energy. He earned Bachelor of Arts (Geography), and Master of Urban Planning degrees from the University of Buffalo.

DANIEL FIORINO

Email: Fiorino.Daniel@epamail.epa.gov

Daniel J. Fiorino is the Director of the Performance Incentives Division at the U.S. Environmental Protection Agency and the program manager for the National Environmental Performance Track program. He also directs projects related to environmental management systems, performance measurement, and partnership programs. He has written extensively on regulation, environmental policy, and public participation, including a public policy text, Making Environmental Policy. He received a Ph.D. in political science from Johns Hopkins University.

KURT FISCHER

Email: kfischer@clarku.edu

Kurt Fischer is co-founder and U.S. coordinator of the Greening of Industry Network, an international research and policy association with offices at Clark University in Worcester, Massachusetts; at the University of Twente in Enschede, The Netherlands; and at Chulalongkorn University in Bangkok, Thailand. Since 1995 he has been Research Professor at Clark's George Perkins Marsh Institute where he focuses on issues of industry, community and environment. From 1985 to 1995 he conducted research and managed programs at the Tufts University Center for Environmental Management including seven years as Director of Research, and he has 18 years prior business experience. Kurt Fischer is co-editor of two titles in the Network book series published by Island Press and author of a number of reports in environmental management. He has organized many international conferences and workshops bringing together diverse professional communities. He earned his bachelor's degree with honors in Social Relations in 1964 from Harvard University and a master's of science degree in Urban & Environmental Policy/Civil & Environmental Engineering in 1986 from Tufts University. He resides in Arlington, Massachusetts.

KENNETH FRIEDMAN

Email: Kenneth.Friedman@ee.doe.gov

Dr. Kenneth Friedman is senior advisor in the Office of Industrial Technologies in the U.S. Department of Energy. He has been with the Department for over 23 years where he has held positions dealing with program evaluation and analysis. For over five years he was the Head of the Energy Technology Policy Division at the International Energy Agency in Paris France where he was responsible for administering over 20 International R&D agreements relating to advanced energy technologies as well as analysis related to future energy technology opportunities, and R&D funding trends. His most recent work relates to the development of metrics for the Industries of the Future program as well as approaches to voluntary government industry cooperation.

ROBERT FROSCH

Email: bob_frosch@harvard.edu

Robert A. Frosch is a theoretical physicist by education. (AB, Columbia College '47 and Ph.D., Columbia University, '52). He conducted research in ocean acoustics at Columbia and later served as Director for Nuclear Test Detection, and Deputy Director of the Advanced Research Projects Agency (ARPA) in the Department of Defense, Assistant Secretary of the Navy for Research and Development (ASNR&D), Assistant Executive Director of the United Nations Environment Programme (UNEP), Associate Director for Applied Oceanography of the Woods Hole Oceanographic Institution (WHOI), Administrator of NASA, President of the American Association of Engineering Societies (AAES), and Vice President of General Motors Corporation (GM) in charge of Research Laboratories. He retired from GM in 1993 before joining the Kennedy School of Government at Harvard University. He is a member of he National Academy of Engineering, the American Academy of Arts and Sciences, a Foreign Member of the UK Royal Academy of Engineering, and a fellow or member of a number of professional societies.

ARCHON FUNG

Email: archon_fung@harvard.edu

Archon Fung is an Assistant Professor of Public Policy. His research focus is improving public and private governance through civic participation, deliberation, and transparency. His Street Level Democracy: A Theory of Popular Pragmatic Deliberation and Its Practice in Chicago School Reform and Community Policing, analyzes two such systems in low income Chicago neighborhoods. In addition to police organization and public education, his current research examines participatory initiatives in ecosystem management, toxics reduction endangered species protection, international labor standards, and local governance in developing countries. His recent books and edited collections include: Can We Eliminate Sweatshops? (Beacon Press, forthcoming 2001), Working Capital: The Power of Labor’s Pensions (Cornell University Press, 2001), Beyond Backyard Environmentalism (Beacon Press, 2000), and Institutions of Justice: Constitutionalism, Democracy, and State Power (Edward Elgar, 1996). Fung has also written on regulatory reform, rights, and popular participation in Politics and Society, Environmental Management, and Boston Review. He received two BSs and a PhD from MIT. He is on leave in the spring of 2002.

ADINARAYANTAMPI GOPALAKRISHNAN

Email: adinarayantampi_gopalakrishnan@harvard.edu

Adinarayantampi Gopalakrishnan was the Chairman of India's nuclear regulatory agency, the Atomic Energy Regulatory Board, from 1993-96. Since his term as AERB Chairman ended, Dr. Gopalakrishnan has publicly criticised India's nuclear establishment for its insufficient attention to safety, excessive secrecy, and lack of accountability. He holds M.S. and Ph.D. degrees in Nuclear Engineering from the University of California, Berkeley; his area of specialisation was nuclear safety. In the United States, he has held senior positions in the University of California, Berkeley, the Argonne National Laboratory, and the Electric Power Research Institute. In India, he has directed the government's Central Mechanical Engineering Research Institute, the advanced research

projects of Bharat Heavy Electricals Limited (India's principal electricity technology supply firm), and the engineering staff of the College of India. In addition to his nuclear work, Dr. Gopalakrishnan holds a number of patents in clean coal technology.

ANDREW GOULDSON

Email: a.gouldson@lse.ac.uk

Andrew Gouldson lectures in environmental policy in the Department of Geography and Environment at and is a member of the Centre for the Analysis of Risk and Regulation the London School of Economics. His research focuses on the performance of environmental policy and regulation and on the nature of the relationship between industrial development and the environment. At the broadest level, he has drawn upon the theory of ecological modernisation to consider the nature of 'progress' and the ability of modern societies to recognise and respond to the environmental risks and impacts that can be associated with continued economic development. He has also worked extensively on environmental regulation where he has examined the influence that different forms of regulation have on the environmental and economic performance of large and small firms and on the development and diffusion of new technologies. Most recently, he has started to assess the influence of environmental risk assessment on corporate governance structures and on industry-stakeholder relations. Gouldson has acted as an advisor to various governmental and non-governmental agencies, including most recently the European Parliament and the European Commission, and as a consultant to a number of industrial bodies. He is Editor of the journal European Environment and is well-known for his book Environmental Management and Business Strategy (with R. Welford - Pitman Publishing, 1993). His latest books are Regulatory Realities (with J. Murphy - Earthscan, 1998) and Integrating Environment and Economy (with P. Roberts -Routledge, 2000).

MARY GRAHAM

Email: mary_graham@harvard.edu

Mary Graham is an Affiliate of the Harvard Information Infrastructure Project. Ms. Graham is a lawyer and writer, and the author of The Morning After Earth Day, a Governance Institute/ Brookings book on U.S. environmental policy published in May, 1999. She was also the recipient of funding from the Woodrow Wilson Center for International Scholars to conduct a conference on emerging issues in environmental policy on September 30, 1999, including the issue of information disclosure as a means of regulation. Graham is a Fellow of the Governance Institute and of Harvard's Kennedy School of Government with broad experience as an analyst of regulatory policies.

MARK A. GREENWOOD

Email: mgreenwood@ropesgray.com

Mark Greenwood, who joined Ropes & Gray in 1994, is Managing Partner in our Washington, D.C. Office. He has extensive experience in environmental law, including chemical regulation, pollution prevention, Superfund, pesticides, hazardous waste management, emergency planning, and toxic substance issues. Prior to joining Ropes & Gray, Mark served for sixteen years at the Environmental Protection Agency, including four years as Director of the Office of Pollution Prevention and Toxics. He also served

as Associate General Counsel for Pesticides and Toxic Substances (1988-90), Assistant General Counsel for Superfund (1987-88), and Assistant General Counsel for RCRA (1983-87). Mark graduated from the University of Michigan with a B.A. in 1974, and earned a J.D. from the University of Michigan Law School in 1978. He also holds a Masters degree in Public Policy from the University of Michigan.

JOHN A. HARRIS

Email: jaharris@ashland.com

John Harris is EH&S Management Systems Coordinator at Ashland Inc. Harris has over 25 years in the EH&S field centered in the chemical industry. Much of his experience has been in the range of EH&S management systems, facility compliance, remediation, due diligence, worker injury and product liability throughout the U.S., Europe and Asia. His efforts related to the development and implementation of environmental management systems have included: Supporting the advancement of the American Chemistry Council's Responsible Care program to the next generation for application in lieu of ISO 14001 certification for addressing customer requirements and environmental policy alternatives; support facilities in their development of ISO 14001 and EMAS efforts on a global basis; responsible for the redesign of Ashland's EH&S programs into a management systems framework to improve EH&S performance and productivity; and co-Leader of the Global Environmental Management Initiatives' (GEMI) project on defining business value between customers and service providers through improving environmental and financial performance of both parties

ANDREW HOFFMAN

Email: ahoffman@bu.edu

Andrew Hoffman is an assistant professor of organizational behavior at the Boston University School of Management. From 1995 to 1997, he was on the organization behavior faculty at the Kellogg School of Management, Northwestern University. His major theoretical interests deal with the nature and dynamics of change within cultural and institutional systems. His empirical interests focus on the managerial, cultural, and institutional aspects of corporate environmental activity. Along with numerous professional and academic articles, he is the author of "From Heresy to Dogma: An Institutional History of Corporate Environmentalism" and the editor of "Global Climate Change: A Senior Level Dialogue." He received his Ph.D. (1995) and S.M. (1991) from the Massachusetts Institute of Technology and his B.S. (1983) from the University of Massachusetts.

PETER HOFMAN

Email: p.s.hofman@cstm.utwente.nl

Peter Hofman, MBA, (1963) is a research fellow at the Center for Clean Technology and Environmental Policy (CSTM) at the University of Twente in the Netherlands since 1995. He publishes and teaches about policy strategies to induce companies towards more sustainable behaviour. Ongoing research activities include a comparative study regarding the integration of environmental policy and technology policy for the European Union, and the management of technology responses to the climate change challenge for the Dutch Scientific Organisation. He currently also holds a position as a post-doc at the

centre for studies of science, technology and society at the University of Twente where he analyses sociotechnical change related to the energy system. Recent publications include: Ahead of the Curve, Cases of Innovation in Environmental Management, edited by Ken Green, Peter Groenewegen and Peter S. Hofman, Kluwer Academic Publisher, January 2001.

JOHN P. HOLDREN

Email: john_holdren@harvard.edu

John Holdren is the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences, at Harvard University. He is also a member of the Board of Tutors for Harvard's undergraduate major in Environmental Science and Public Policy; Distinguished Visiting Scientist and Vice Chair of the Board of Trustees at the Woods Hole Research Center; and Professor Emeritus of Energy and Resources at the University of California, Berkeley (where he was co-founder in 1973 of the campus-wide, inter-disciplinary, graduate-degree program in Energy and Resources in which he served variously as Vice Chair, Chair, and Chair of Graduate Advisors until 1996). Dr. Holdren is Chair of the Committee on International Security and Arms Control of the National Academy of Sciences, a member of the Board of Directors of the John D. and Catherine T. MacArthur Foundation, and a member of President Clinton's Committee of Advisors on Science and Technology (PCAST). He has chaired PCAST panels on protection of nuclear-bomb-materials (1995), the U.S. fusion-energy R&D program (1995), U.S. energy R&D strategy (1997), and international cooperation on energy (1999); and in 1996-7 he co-chaired with E. Velikhov the U.S.-Russian Independent Scientific Commission on Plutonium Disposition (reporting to Presidents Clinton and Yeltsin). He also chairs National Academy panels on the spent-fuel standard for plutonium disposition, on technical issues related to the Comprehensive Test Ban Treaty, and on US-India energy cooperation. He recently received the 1999 Kaul Foundation Award for Excellence in Science and Environmental Policy, the 2000 Tyler Prize for Environmental Achievement, and the 2001 Heinz Prize in Public Policy.

IRA A. JACKSON

Email: ira_jackson@ksg.harvard.edu

Ira A. Jackson is director and faculty chair of the Center for Business and Government. Jackson was previously executive vice president of BankBoston, where he was responsible for a variety of corporate activities, including economic analysis; regulatory affairs; philanthropy; community, press, and governmental relations; public affairs; community banking and CRA; global projects; and corporate communications. He has served as a top policy adviser to two mayors: Kenneth Gibson of Newark, New Jersey, and Kevin White of Boston; and served as Massachusetts Commissioner of Revenue. He holds an MPA from KSG and attended the Advanced Management Program (AMP) at Harvard Business School. From 1976-1982 he was Associate Dean of the Kennedy School. He is active in a variety of civic institutions, including the World Affairs Council, WBUR, Facing History and Ourselves, CityYear, the Boston Foundation, and Junior Achievement International. He is currently working on Capitalism with a

Conscience: The Ethical Imperative for Business in the New Global Economy. Jackson's career, teaching, and research interests focus on making government more entrepreneurial; encouraging business to act more responsibly; and engaging civil society more centrally in advancing social justice.

TIM JENKINS

Email: timj@foe.co.uk

As Research Coordinator for Friends of the Earth England, Wales and Northern Ireland Jenkins manages the implementation of the organisation's programme of strategic research. In addition, he manages FOE's Modern Economy Programme developing policy and managing research and campaigns on national and regional economic policy issues. He has written and edited numerous reports, briefings and papers for FOE on the employment impacts of environmental policies, the use green taxes, voluntary approaches to environmental policy and regional development. He is currently a member of BSI's Certification Environmental Advisory Council. Tim's doctoral research examined the relationship between environmental regulation and innovation in the chemicals industry. He has worked for FOE's Campaign Department since January 1990.

XU JING

Email: xuj@mail.most.gov.cn

Xu Jing comes to us from Beijing China, where he has been at the Ministry of Science and Technology (MOST) in China, in various positions since 1994. He is currently the Director of the Division of Energy and Transportation, managing the Dept. of High-Tech Development and Industrialization, and program planning in the fields of energy and transportation. He is the Coordinator of the US-China fossil fuel technology cooperation protocol between the U.S. Dept. of Energy, and MOST; and the editor of the Journal of Clean Coal Technology, in China. Prior to MOST, he was Associate Professor, in the Dept. of Mechanical Engineering, Northern Jiaotong University in Beijing. He is working on US-China Energy Cooperation in the Energy Technology Innovation Project (ETIP).

HELGE JÖRGENS

Email: ffu@zedat.fu-berlin.de

Helge Jörgens is Research Fellow at the Environmental Policy Research Unit of the Free University of Berlin since 1994 and Research Fellow at the German Council of Environmental Advisors since 1999. His main areas of research are comparative environmental policy and waste policy. Recent research projects include „The Diffusion of Environmental Policy Innovations“ (VolkswagenFoundation) and Negotiated Environmental Agreements – Policy Lessons to be Learned from a Comparative Case Study“ (European Comission). Publications include „Strategic Environmental Planning and Uncertainty: A Cross-National Comparison of Green Plans in Industrialized Countries“, Policy Studies Journal, Vol. 28, No. 3, pp. 612-632 (together with Martin Jänicke), „The Diffusion of Environmental Policy Innovations“, Environmental Politics, Vol. 10, No. 2 (forthcoming) and „Strategien der Nachhaltigkeit. Umweltplanung im internationalen Vergleich“, Berlin et al., Springer (volume edited together with Martin Jänicke).

ULRIK JØRGENSEN

Email: uj@its.dtu.dk

Ulrik Jørgensen is an engineer by training, having graduated in 1979 as Master of Engineering from DTU. He specialized in electronics and automation, and finished his Ph.D., which focused on innovation and industrial economics based on studies of the internationalization of Danish electronics industry, in 1985. Currently he is Associate Professor in the Department of Technology and Social Sciences at Danish Technical University. His research is centered around the study of technology and engineering practices in a social context. The later years of his work has been concentrated on the development of theoretical positions and methods aimed at the understanding of the role of material objects for the interpretation and use of technologies. Jørgensen has also studied how engineering practices and experience shape the professional competences in engineering work. In his earlier research, Jørgensen had worked on studies of industrial innovation, technology policy, environmental regulation, and information technology with emphasis on standards and new electronic media. He is now engaged in research projects concerning 'sewers and the restructuring of engineering and cities', 'transport technology and new policy concepts', 'technology management and frames for innovation', and 'the foundations of modern engineering competences'.

JOHN "SKIP" LAITNER

Email: laitner.skip@epa.gov

Skip Laitner is a resource economist with 30 years experience in public policy analysis, economic impact studies, and economic development planning. He currently serves as the Senior Economist for Technology Policy for the EPA Office of Atmospheric Programs. In that capacity, Skip was awarded EPA's 1998 Gold Medal for his work with a team of EPA economists that helped lay the foundation for the recent Kyoto Protocol on Greenhouse Gas Emissions. Skip is a frequent lecturer and has appeared as an expert witness in more than four dozen legal hearings and adjudicatory proceedings throughout the country. He has testified on a variety of issues before legislative committees in Congress and in numerous states. He has conducted technical addition to his expert testimony, Skip has written a large number of papers and reports in the fields of community and economic development, decision sciences, energy and utility costs, and natural resource issues. He recently joined the Virginia Polytechnic Institute and State University as an adjunct faculty member, teaching a graduate course on the Economics of Technology in the Science and Technology Studies program. Skip has a master's degree in resource economics

HENRY LEE

Email: henry_lee@harvard.edu

Henry Lee holds three positions at the John F. Kennedy School of Government. He is the Jaidah Family Director of the Environment and Natural Resources Program, within the Belfer Center for Science and International Affairs, Faculty Co-Chair of the Kennedy School International Infrastructure Program, and a Lecturer in Public Policy. Before joining the School in 1979, Mr. Lee spent nine years in Massachusetts state government as Director of the State's Energy Office and Special Assistant to the Governor for environmental policy. He has served on numerous state, federal, and private advisory

committees on both energy and environmental issues, and is working with private and public organizations, including the Department of Energy, Interior, U.S. EPA, the National Park Service, the Pew Foundation, the Brazilian National Development Bank, the Inter American Development Bank and is on the board of several corporations. His research interests have focused on electricity and water privatization, environmental management, global climate change, and the political economy of energy. He is the editor of Shaping Responses to Climate Change, the report of the Harvard Global Environment Policy Program and is the author of a recent report on Electricity Restructuring and the Environment.

KRIS LULOFS

Email: k.r.d.lulofs@cstm.utwente.nl

Dr. Kris Lulofs is a senior researcher at the Center for Clean Technology and Environmental Policy (CSTM) of the University of Twente in the Netherlands. He specializes in topics as environmental policy, pollution prevention and environmental management in companies. He teaches Environmental Management within several postgraduate courses and for under-graduates.

ALFRED MARCUS

Email : amarcus@csom.umn.edu

Alfred Marcus received his Ph.D. in 1977 in government from Harvard University. Currently he is Professor of Management in the Strategic Management and Organization Department at the Carlson School of Management of the University of Minnesota. He is completing a manuscript on Project XL for RFF Press called Finding Common Ground. He recently co-edited a special issue of Academy of Management Journal on management of organizations in the natural environment. The second edition of his text, Business and Society: Strategy, Ethics, and the Global Economy, was published by Irwin in 1996. His work has appeared in such leading management journals as the Academy of Management Journal, Academy of Management Review, and Strategic Management Journal.

ROBERT MARGOLIS

Email: robert_margolis@harvard.edu

Robert Margolis is an STPP Fellow, is also a Ph.D. candidate in the Science, Technology and Environmental Policy Program at Princeton University's Woodrow Wilson School of Public and International Affairs. He is broadly interested in the role of scientific and technical information in the policy-making process, particularly as it relates to environmental sustainability issues. His main research interests include: Energy technology and policy; research, development and demonstration policy; and energy-economic modeling. His dissertation research focuses on developing a better understanding of the process of technological innovation in the energy sector. This research aims to identify policies and institutions that are likely to foster innovation on environmentally sound energy technologies. Before attending Princeton, Robert spent a couple of years working as a Research Associate at the Stockholm Environment Institute's Boston Center (SEI-B). While at SEIB he focused on social, technical, and policy issues related to sustainability. Prior to joining SEI-B, Robert worked as a

Research Assistant at M.I.T.'s Center for Energy and Environmental Policy Research, where he conducted research on a number of issues related to global environmental change. He received a Master of Science degree in Technology and Policy from the Massachusetts Institute of Technology in 1992, and a Bachelor of Science degree in Electrical Engineering from the University of Rochester in 1988.

ROLF MARSTRANDER

Email: Rolf.Marstrander@hydro.com

Rolf Marstrander was born in Oslo 1935. He has a Masters degree in Industrial Engineering from the Norwegian Technical University and a PMD from the Harvard School of Business. Marstrander is currently an adjunct professor of Industrial Ecology at Norwegian University on Science and Technology (NTNU). He was also vice president of the Norwegian Research Counsil (1972 –78) with responsibility for the coordination of initiatives and programs related to environmental research; Head of Norwegian pollution control authorities (1978-82); Senior Vice President of Norsk Hydro (1982-2000); Head of Health Safety Environment Corporate (1982-91). During the period 1972-2001 he has been on the boards of several of the major research institutes and programs of relevance to environment or environmental policies in Norway. He has been active in international industrial organizations on the same topics.

ROBERT KINLOCH MASSIE

Email: massie@ceres.org

Dr. Massie is currently executive director of CERES (Coalition for Environmentally Responsible Economies), the largest U.S. coalition of investors, public pension trustees, foundations, labor unions, and environmental, religious and public interest groups working in partnership with companies to encourage corporate social and environmental responsibility worldwide. He has been working on issues of corporate governance and responsibility for two decades. Dr. Massie began working for the U.S. Senate Subcommittee on Investigations and later for Ralph Nader's Congress Watch. An ordained Episcopal minister, Dr. Massie received his master's degree in social and theological ethics from Yale Divinity School in 1982 and his doctorate in business policy from Harvard Business School in 1989, where his research focused on the methods used by large institutional investors to make decisions about social issues. From 1989 to 1996 Dr. Massie taught at Harvard Divinity School where he ran the Project on Business, Values and the Economy. In 1993, as a senior Fulbright Scholar, he served for six months on the faculty of the University of Cape Town's Graduate School of Business. Mr. Massie's book, Loosing the Bonds: The United States and South Africa in the Apartheid Years, was published in 1998 by Doubleday and was awarded the 1998 Lionel Gelber Prize, the largest juried award of its kind in the world, for the best book on international relations.

SHELLEY METZENBAUM

Email: shelly_metzenbaum@harvard.edu

Dr. Metzenbaum is the Director of the Performance Management Project at the Kennedy School of Government and a Visiting Professor at the University of Maryland School of Public Affairs, where she runs the Environmental Compliance Consortium. Previously,

Metzenbaum served as Associate Administrator of the U.S. Environmental Protection Agency for Regional Operations and State/Local Relations, Undersecretary of the Massachusetts Executive Office of Environmental Affairs, and Director of Capital Budgeting for Massachusetts. Recent publications include "Measurement that Matters: Cleaning Up the Charles River" forthcoming in Donald F. Kettl, ed., Environmental Governance: A Report on the Next Generation of Environmental Policy (Brookings Institution Press, 2001); "Information, Environmental Performance, and Environmental Management Systems," in Cary Coglianese and Jennifer Nash, Regulating from the Inside (RFF Press 2001); and "Making Measurement Matter: The Challenge and Promise of Building a Performance-Focused Environmental Protection System," (Brookings Center for Public Management 1998).

CATHERINE MILLER

Email: cmiller@hampshire.org

Dr. Miller has been closely associated with the US Toxics Release Inventory (TRI) since its inception, when Hampshire Research helped the US Environmental Protection Agency establish data analysis and public dissemination practices. Annually, she conducts data extraction, data quality review, and analysis for the national TRI reports. She also assisted the US EPA in the design of the system for reporting industry progress under the voluntary 33/50 Program, which set voluntary reduction goals of 17 TRI chemicals. She maintained the Program's database and produced periodic progress reports. Dr. Miller helped develop case studies of participating companies that examined chemical use and reduction methods as well as assessments of the economics of the reductions. The case study work grew out of earlier efforts at INFORM where Dr. Miller co-authored studies of hazardous waste reduction in chemical plants. Since 1994, Dr. Miller has led a three-country team in producing the North American Commission for Environmental Cooperation's annual data reports, covering Pollutant Release and Transfer systems in Canada, Mexico and United States. This effort is unique in presenting cross-country information and offers a reliable model and methodology to others who may seek to aggregate somewhat disparate regional data.

JENNIFER NASH

Email: jennifer_nash@harvard.edu

Jennifer Nash is director of the Regulatory Policy Program at Harvard University's Kennedy School of Government. She recently co-edited, with Cary Coglianese, Regulating from the Inside: Can Environmental Management Systems Achieve Policy Goals?, published by Resources for the Future Press. She has also published in California Management Review; Business, Strategy and the Environment; the Annual Review of Energy and the Environment; and Environment magazine. Previously, she was associate director of the Technology, Business, and Environment Program at the Massachusetts Institute of Technology and executive director of the Delaware Valley Citizens Council for Clean Air.

BILL NICKERSON
Email: silenstvi@yahoo.com
Bill Nickerson is a Masters student at MIT in the Technology and Policy Program, where he is studying and researching environmental policy. He has a MSc. from Oxford University in Environmental Change and Management and a Bachelors degree in Civil Engineering. Bill worked for a number of years in environmental litigation between bouts of academia.

VICKI NORBERG-BOHM
Email: vicki_norberg-bohm@harvard.edu
Dr. Vicki Norberg-Bohm is the Director of the Energy Technology Innovation Project (ETIP) at the Belfer Center for Science and International Affairs, Harvard University. ETIP focuses on the policies and institutional changes needed to develop and deploy a new generation of energy technologies that can address the multi-faceted challenges in the energy sector, including environment, development and security. Prior to joining the Belfer Center, Dr. Norberg-Bohm was an assistant professor in the Department of Urban Studies and Planning at MIT. While at MIT, she was co-PI of the Environmental Technology and Public Policy Program, and part of the research team on "Creating Incentives for Environmentally Enhancing Technological Change" at MIT's Center for Environmental Initiatives. From 1998 -1999, she was also co-Director of the Program for Environmental Education and Research, which focused on developing multidisciplinary educational initiatives. She has a Ph.D. in Public Policy from Harvard University. Prior to returning to school to pursue a Ph.D., she was a practicing engineer in the area of energy and environmental systems. She has a M.S./ B.S. in Mechanical Engineering from Washington University in St. Louis.

BRUCE PATON
Email: paton@cats.ucsc.edu
Bruce Paton is Executive Vice President and Chief Sustainability Officer for Rolltronics Corporation, a Silicon Valley electronics company. Bruce has more than twenty years of experience in industry, government and higher education. He holds a BA in Environmental Science from Wesleyan University, an MBA from Stanford University, and is in the final stages of completing his Ph.D. in Environmental Studies at the University of California, Santa Cruz.

JERRY ROGERS
Email: jerry.rogers@gm.com
Jerry Rogers received a Bachelor of Science degree in Chemistry from West Virginia University in 1976 and a Ph. D. in Physical Chemistry from the University of Florida in 1980. He served two years as a National Research Council / Resident Research Associate at the NASA Goddard Space Flight Center in Greenbelt, MD, where he analyzed infrared spectra of interstellar clouds. He has worked at the General Motors Research and Development Center since 1982. As a Senior Research Scientist in the Environmental Research Department from 1982 – 1987, he was involved in developing and validating techniques for measuring automotive tailpipe emissions. From 1987 – 1990, he was Staff Research Scientist with research interests in atmospheric chemistry

and in air toxin emissions from manufacturing operations. He also provided scientific advice to the General Motors on stratospheric ozone depletion and climate change issues. From 1990 – 1998, he was a Section Manager responsible for Manufacturing Emissions and Health in the Health and Environment Department. His duties included the management of scientists conducting research to mitigate environmental impacts of casting, machining, and painting operations. From 1998 – present, he has been Group Manager of Environmental Systems for Advanced Materials in the Chemical and Environmental Sciences Laboratory. He is responsible for managing a group of scientists, engineers, and health professionals conducting research on product and process health and safety, fuel cell programs, and catalysis. In 2000, he was also named GM Technical Director for the Partnership for a New Generation of Vehicle (PNGV). He has served on several cooperative industrial and government panels, including the National Center for Manufacturing Sciences, the National Defense Center for Environmental Excellence, and the Casting Emission Reduction Program.

AUDUN RUUD
Email: audun.ruud@prosus.uio.no
Audun Ruud has an MBA degree from Norwegian School of Economics and Business Administration (NHH), and a master degree of political science from the University of Oslo (UiO). Currently, he is in a process of submitting his doctoral dissertation in political science, which is based on studies of transnational corporations (TNCs) and their environmental considerations in less developed countries (LDCs). Ruud is affiliated with the Programme for Research and Documentation for a Sustainable Society (ProSus), a strategic university programme hosted by the Centre for Development and the Environmental at UiO. ProSus is designed to monitor and evaluate Norway's follow-up of the United Nations Conference on Environment and Development (UNCED). He is particularly concerned with the role of business and public services in promoting sustainable production and consumption of energy and transport.

GEERTEN SCHRAMA
Email: g.j.i.schrama@cstm.utwente.nl
Geerten Schrama is at the faculty of Public Administration and Public Policy of the University of Twente since 1985. As of 1992 he is working as senior research associate at the Centre for Clean Technology and Environmental Policy. In 1984 he graduated cum laude in organizational sociology at the University of Amsterdam. In 1991 received his Ph.D. at the University of Twente with a dissertation on personnel information systems at large municipalities. His present research at the CSTM is on governmental steering in interaction with social actors. Fields of application are stimulation of environment-oriented innovations, stakeholder analysis and the role of financial institutes. He was the coordinator of the EU research project "Water supply authorities in Europe preventing agricultural water pollution", and he has participated in two other EU research projects. Apart from his scientific work he is also a member of the board of the university council.

NILS THORSEN
Email: nils.thorsen@dk.eyi.com
Nils Thorsen is senior Manager at Ernst's and Young's Center for Stakeholder Reporting. Since 1979, Thorsen has had public and private employment in the field environmental management with the Ministry of the Environment, the National Environmental Protection Agency, the Environmental Protection Agency of the City of Copenhagen, the Technical University of Denmark, and Novo Nordisk A/S.

CHARLES WHITE
Email: cdwhite@socrates.berkeley.edu
Chad White is a doctoral student at UC Berkeley in the multi-disciplinary Energy and Resources Group. Prior to graduate school, Chad worked as an engineer/environmental consultant on regulatory development projects with the US EPA Office of Air. His graduate research examines the changing nature of regulatory institutions as environmental reform increasingly moves out from under direct state purview and into the realm of voluntary commitments and self-regulation. In particular, Chad is interested in the way in which "environmental performance" is defined, measured, and managed in the course of pursuing voluntary means of environmental protection. Working on an analysis of voluntary programs at the Department of Energy, Chad will spend the 2001-2002 academic year as a Kennedy School fellow with Dr. Vicki Norberg-Bohm and Professor John Holdren.