Industrial Pollution, Regulation and Growth: Governance Challenges and Innovations

The 2012 San Servolo Workshop on Grand Challenges of Sustainability

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Sustainability Science Program
Working Paper 2012-02

July 2012

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Abstract
Sustainable development requires government, industry and citizens to work together. The environmental costs of rapid growth, such as the depletion of natural resources and air and water pollution, may be checked by designing and implementing better environmental regulation. An executive session convened by the John F. Kennedy School of Government at Harvard University and the Venice International University on May 28–29, 2012 attracted leading experts from the fields of research, business, civil society and policy to San Servolo Island for an intensive two-day session. The goal of the Workshop was to identify regulations of industrial pollution and implementation methods for them that could work in the developing world, and to share experiences with such innovations. In the sessions, one overarching theme that emerged was the need for a long-term view of regulation that emphasizes process and structure and encourages the involvement of both public and private stakeholders through the strategic use of incentives. Such a broad approach to regulation requires more than one technique: participants discussed a range of tools from traditional command-and-control to innovative market-based mechanisms—as well as incentives from rewards to fines to voluntary initiatives—all of which can be used, combined, and adapted to particular circumstances. Other themes visited often during the Workshop were the importance of knowledge dissemination, transparency, and consistency in the application of regulation, and the need for high-quality data and how to gather it. All these would, in turn, enhance regulator credibility—a necessary feature of a well-functioning regulatory environment. The session was one in a series on Grand Challenges of the Sustainability Transition organized by the Sustainability Science Program at Harvard University with the generous support of the Italy’s Ministry for Environment, Land and Sea. This summary report of the session is our synthesis of the main points and arguments that emerged from the discussions. It does not represent a consensus document, since no effort was made at the session to arrive at a single consensus view. Rather, we report here on what we heard to be the major themes discussed at the session. Any errors or misrepresentations remain solely our responsibility.

Keywords: industrial pollution, climate change, sustainable development, environmental policy, sustainability

Citation: This paper may be cited as:
**Grand Challenges of the Sustainability Transition**

This report emerges from the fifth in a series of intense workshops and study sessions on Grand Challenges of the Sustainability Transition, organized by the Sustainability Science Program at Harvard University, hosted by Venice International University, and supported by the Italy’s Ministry for Environment, Land and Sea. This year, the Workshop was led by the Evidence for Policy Design program at the Center for International Development at Harvard University.

The first session in the series addressed Grand Challenges in Sustainability Science. It was convened in October 2006 by William Clark, Co-Director, Sustainability Science Program at Harvard University; John Holdren, President, American Association for the Advancement of Science and Professor, Harvard University; and Robert Kates, Co-Chair, Initiative on Science and Technology for Sustainability.

The second session held addressed goals and concerns surrounding the debate over government policies related to the greater use and production of biofuels. It was convened in 2008 by Henry Lee, Ricardo Hausmann, and Robert Lawrence at Harvard University and Melinda Kimble, United Nations Foundation.

The third session held addressed actionable solutions for making water a force for improved human health and well being in the development agenda. It was convened in 2009 by Michael Kremer at Harvard University; Alix Zwane at Global Development, Bill and Melinda Gates Foundation; and Azzam Alwash at Nature Iraq.

The fourth session held addressed enhancing food security in an era of global climate change. It was convened in 2010 by William C. Clark, Calestous Juma, Noel M. Holbrook, and Nancy Dickson at Harvard University; Patti Kristjanson at World Agroforestry Centre; Bruce Campbell at University of Copenhagen; and Gerald Nelson at the International Food Policy Research Institute.

The reports of these workshops are available at:
http://www.hks.harvard.edu/centers/mrcbg/programs/sustsci/events/san-servolo-roundtables

**The Sustainability Science Program at Harvard University:** The Sustainability Science Program harnesses Harvard University’s strengths to promote the design of institutions, policies, and practices that support sustainable development. The Program addresses the challenge of sustainable development by advancing scientific understanding of human-environment systems, improving linkages between research and policy communities, and building capacity for linking knowledge with action to promote sustainability. The Program supports major initiatives in policy-relevant research, faculty research, training of students and fellows, teaching, and outreach. Further information is available through the Program website at http://www.hks.harvard.edu/centers/mrcbg/programs/sustsci, or from co-Directors William C. Clark (william_clark@harvard.edu) or Nancy Dickson (nancy_dickson@harvard.edu), at the Center for Business and Government, Harvard Kennedy School, 79 JFK Street, Cambridge, MA 02138 USA.

**Evidence for Policy Design at Harvard University:** Evidence for Policy Design (EPoD) at the Center for International Development at Harvard University is a research program that promotes the use of rigorous evidence to inform the design of public policies in low-income countries. We engage with governments and local organizations to identify key questions in international development, use economic theory to design policy responses, and evaluate these via large field-based experiments. Current research topics at EPoD include governance, education, entrepreneurship, health, agriculture, sustainable development, and access to finance. We are creating a network of researchers, practitioners, and policymakers around these issues in order to understand, inform, and design public policy. Further information is available through the website
at http://www.hks.harvard.edu/centers/cid/programs/evidence-for-policy-design, or from Associate Director Deanna Ford (deanna_ford@hks.harvard.edu).

**Venice International University:** Venice International University (VIU) is an international higher education and research center on the island of San Servolo in Venice- VIU includes twelve international universities and important italian institutions such as the Italian Ministry for the Environment, Land and Sea (IMELS) and the Italian National Research Council (CNR). VIU offers advanced training and research in an international context, by promoting the exchange of ideas and knowledge. VIU’s work on sustainability is pursued through The Center for Thematic Environmental Networks (TEN). TEN promotes capacity building, workshops and advanced seminars on key issues of sustainable development with particular focus on emerging economies. (www.univi.org/research-training/research-ten).

**Author Acknowledgements:** We wish to extend sincere thanks to Corrado Clini for his support and guidance in making the 2012 San Servolo Workshop possible. We also thank Alessandra Fornetti and Elisa Carlotto at Venice International University for their support in making the workshop possible, and Vestal McIntyre and Elizabeth Walker for assistance in writing this report.
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Industrial Pollution, Regulation and Growth:  
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1. The Challenge

Rapid industrial growth lifts people out of poverty but also leads to increased environmental pollution. Pollution levels in many developing countries exceed the highest concentrations ever recorded in developed countries. Pollution is known to harm health and the estimated social costs due to pollution are very large (Chen et al. 2010; Xie 1998; MoEF 1999). Recent research has shown, moreover, that pollution decreases labor supply and productivity directly (Hanna and Oliva 2011; Ziven et al. 2011).

While these problems are broadly recognized, environmental regulation in developing countries must strike a delicate balance, because many of the economic activities that create pollution—from transport to industry and electricity production—are themselves important for growth. Tight regulation using traditional models could therefore do real economic harm. We focus on the common regulatory challenges in three broad areas: monitoring pollution, extending regulatory capacity through society, and balancing environmental quality and growth.

1.1 Monitoring Pollution

Statement of Problem

Identifying pollution sources and quantifying emissions levels is hard. Collecting information is costly and the process requires technical expertise and the cooperation or consent of polluters themselves. Yet, without data, regulation may be stalled at the stage of identifying and quantifying the importance of different environmental problems and their causes. Accurate and timely information is crucial in order to design sensible policy and to enforce environmental regulations already on the books.

Challenges

Scope of Monitoring. The sources and types of potential environmental problems are vast and vary greatly. Even among industrial point sources, hundreds of different pollutants pose varying degrees of risk to human and environmental health. Common pollutants, such as the set of six criteria air pollutants widely monitored in the US, provide a useful starting point for policymakers designing regulations, but well-designed regulatory systems must encompass a huge range of potential hazards and build-in flexibility to adapt to unintended consequences and new hazards that arise over time.

Quality of Monitoring. Pollution in developing countries often originates from diverse, small-scale sources. Effective regulatory programs should take this into account, focusing on wide-reaching and affordable designs, and on targeting the most pressing pollution problems. At the same time, monitoring is a source of information: for the regulator, on the effectiveness of its programs; for firms, on their own abatement and compliance with standards; and for the public, on the environmental hazards they face.

Existing monitoring systems are often insufficient in providing regulators the information they need to set rational policy. The economic activity that causes pollution, from transport to small-
scale manufacturing, is often very dispersed in developing countries. Furthermore, many pollutants are not monitored with sufficient frequency, preventing regulators from receiving the information needed to take timely action and bring about abatement. Rather than measuring the final pollution outcomes that affect health and that society is interested to control, some monitoring systems may substitute what is easy to measure. The use of proxies for pollution must be designed with care, as such an approach may distort incentives for abatement.

Higher quality monitoring is costly, particularly for smaller firms, and so must be balanced against the harm of the pollution problem. While the ideal monitoring system encompasses measurements of both total pollutant mass (or load) at source and related ambient measures of air and water quality, such a regime is often prohibitively costly. In Brazil, it is estimated that the industrial effluent from thousands of small and medium-sized enterprises (SMEs) goes unmonitored (Lucon and Rei 2006). In Tamil Nadu, India, cracking down on plants using chemical dye led SMEs to outsource polluting job work to individual households outside the sphere of environmental regulation.

Infrequent monitoring also deadens incentives for abatement. In India, many industrial plants are monitored for air emissions only once every several years. As a substitute for close monitoring of emissions, firms in some areas are mandated to install air pollution control measures such as bag filters or scrubbers. Capital equipment cannot substitute for rigorous monitoring, as without monitoring firms have no incentive to operate costly abatement equipment once installed. More subtly, infrequent monitoring may distort incentives for abatement by changing the nature of pollution standards away from what matters for environmental quality. During infrequent visits, regulators can observe pollutant concentrations, but not total emissions load, and so standards are often specified in terms of concentrations. The concentration of a pollutant, however, can be changed by simple dilution, and it is the total effluent load or emissions mass that affects ambient environmental quality.

**Holistic Regulation and Accountability.** The goal of monitoring is not merely to enforce penalties with respect to a single source but also to develop a holistic understanding of the relationship between source emissions and environmental problems. For example, at a global scale, the basic facts of greenhouse gas emissions are not in dispute. However, there is continual disagreement over responsibility for abatement. When considering environmental pollution at a local or regional scale, the problems are not quite as complex, but many of the same contentious liability issues arise. Monitoring that is designed and executed in a way that creates accountability and links source emissions to environmental problems is more likely to be successful. Regulatory review processes that maintain integrity, quality and transparency tend to inspire greater confidence, trust and cooperation from industry and civil society.

The promise and challenges of holistic regulation are evident in Environmental Impact Assessments (EIAs). EIAs assess the direct and indirect impacts of a project on an ecosystem. If thoroughly done, assessments cover an array of possible effects on the environment and often include estimates of pollution control costs to inform a cost-benefit analysis of mitigating the project’s foreseeable impacts. In practice, EIA reports often do not live up to their comprehensive ideal due to incentive problems and poor follow-up. The incentive problem, as stated by a former Minister of the Environment in India, is that “the person who is putting up the project will be preparing the assessment report” (The Hindu 2011). That is, the project proponents, with a strong interest in seeing that the environmental impacts of the project are stated to be minimal, hire the consultant that writes the EIA. Regarding follow-up, even a high-quality initial report will be meaningless if projects are not held to the standards set in their EIA after construction begins (Panigrahi and Amirapu 2012).
1.2 Extending Regulatory Capacity throughout Society

Statement of Problem
Traditional top-down regulation has structural flaws. Regulators have limited capacity and resources. Furthermore, they may have poor information about local pollution problems and inconsistent will to enforce regulations. Industry has no interest in promoting rigorous enforcement, though it is very well informed about the nature of production and the costs of abatement. Citizens have little power and few resources but are both interested in improving environmental quality and often well informed about local problems. Because environmental quality is a public good, from which all benefit regardless of their own contributions, it will tend to be undersupplied by individual citizens.

The scale of environmental problems in developing countries is massive. It is unrealistic in practice, and has proven foolhardy by experience, to expect government mandates alone to improve environmental quality. Government regulation is necessary as a framework for reducing pollution, but regulators themselves do not have the capacity or the will to achieve societal goals. With a well-designed regulatory structure, civil society and private firms can serve as vigilant extensions of state capacity for monitoring and enforcement of environmental regulations.

Challenges

Transparency. Pollution control through information disclosure, heralded as a new wave in environmental regulation, depends on transparency that leads to regulatory feedback. Transparency is vital because citizens need information in order to judge the environmental risks they face and the sources of those risks. Regulatory feedback, through formal or informal mechanisms, is needed because even public outrage will not change environmental quality if there are no means for citizens to influence pollution control.

Transparency in environmental regulation begins with disclosure. Basic disclosure policies have been getting stronger in recent years. In India and in China, the Environmental Impact Assessment (EIA) process requires the inclusion of civil society through public hearings and other means. In India, the Right To Information (RTI) Act has led to an explosion in environmental queries and litigation, as in other areas of the law (PRIA 2007). Some information policies modeled on the US Toxic Release Inventory, such as Indonesia’s PROPER, the Philippines’ Eco-watch, and the Chinese GreenWatch, try to create public pressure on firms to clean up by disclosing their emissions or relative environmental performance (Garcia et al. 2007). The low cost of these policies, which often release information the government already collects, has a universal appeal to governments.

The bigger challenge in using transparency in regulation involves building channels through which public response can feed back to regulatory sources. In some cases the public has a large nominal or statutory role in the EIA process but little actual influence (Zhao 2010). In general, research suggests that the ability of communities to engage in monitoring is increasing with income and education, though this may only be due to the fact that wealthier, better educated people prefer to live in cleaner communities (Pargal and Wheeler 1996). The overall evidence on the ability of civil society to influence compliance is clouded by issues of measurement. Blackman (2010) surveys the field and concludes that there is not compelling evidence that alternative pollution control policies based on disclosure spur significant improvements in environmental performance.
Incentives and Resources for Independent Third Parties. Private firms have expertise that can help in improving environmental quality. Consultants may have monitoring and analysis skills on par with or beyond the government itself, and polluting plants themselves have the best knowledge of their own process and abatement costs. Drawing on these skills and this knowledge is possible only to the extent that the profit motive of these parties is aligned with regulatory goals.

In developing countries especially, regulators may not have the institutional capacity to properly certify and monitor auditors. In such settings, firms can shop around for the best auditors and third-party auditors are often incentivized to give firms a passing grade in exchange for a higher payment. Auditors must balance this incentive against the risk of being censured or disbarred by the government regulator.

1.3 Balancing Environmental Quality and Growth

Statement of problem

Reducing pollution is costly to firms: it often requires them to install new equipment, to use more expensive inputs and manpower, or to cut back on production or relocate. In developing countries, this trade-off between environmental quality and growth is more direct because incomes are lower and polluting activities are more important to the economy. Policy that ignores these compliance costs risks losing the buy-in and support from regulated firms. Regulators can set and achieve more ambitious environmental targets by incorporating compliance costs into policy design.

Challenges

Balancing Incentives across Abatement Options. The cheapest way to reduce a given pollutant may be through end-of-pipe controls or through other changes, such as process modifications or better operations and maintenance of existing equipment. Regulation will ideally provide a balanced incentive to abate that does not favor one means of abatement over another. More often, existing regulation provides incentives for observable, lumpy capital investments associated with installing abatement technologies but not for the ongoing costs associated with compliance.

Tilting the playing field to provide equal incentives for different abatement options in general will raise total costs. In the US, some coal plants have a relatively lower cost of capital due to regulations that compensate them for capital expenditures. Fowlie (2010) studied how this lower cost of capital affected the abatement decisions of plants within a regional NOx trading market. Among physically similar plants, those in deregulated markets were less likely to adopt capital-intensive compliance options. This implies that other, non-capital means of abatement were preferred in order to comply with the cap when the decision was left to the open market. Policies that artificially lower the cost of abatement capital in developing countries, such as air pollution control measure subsidies, likely have a similar effect and may therefore increase total costs.

Balanced incentives depend on balanced monitoring of pollution outputs, as discussed above. If pollution cannot be monitored, but capital can be observed, then verifying the installation of capital equipment may be the best the regulator can do. Equipment mandates, however, will still only be worthwhile if it is possible to somehow check that the equipment is run. With no verification and a positive cost of operation, equipment will not be used, and industry will rightly view mandated installation as a waste.
Steady Incentives or Penalties. Inconsistent application of government rules makes the compliance process antagonistic and reduces the willingness of industry to cooperate with regulation. Given that firms are monitored infrequently, and that monitoring results are not immediately disclosed, regulators have a great deal of discretion in determining compliance. Moreover, to bring about any compliance with infrequent monitoring requires massive penalties if violations are detected. Regulators are challenged, as monitoring allows deeper examination of sources, to provide steady incentives for compliance and consistent penalties for noncompliance rather than conducting costly, infrequent crackdowns.

Many industrializing economies, such as India and China, have a history of harsh sanctions for noncompliance with environmental regulations and dramatic shifts in enforcement. In landmark cases in 1995 and 2001, the Supreme Court of India ordered thousands of industrial plants in Delhi to leave the city and to pay their workers compensation. This surely reduced industrial pollution in Delhi, but also presented a sudden and very costly order for both industry owners and poor laborers. The Central Pollution Control Board has recently applied equally broad, though temporary, restrictions on investment in severely polluted industrial estates. Even when more precise regulatory instruments have been available to identify primary violators, they are not always used. For example, China has discussed and piloted market-based instruments for air pollution control, but still often uses drastic measures such as forced industrial relocations, construction bans, and traffic restrictions to meet environmental targets.

Steady incentives or penalties have the further advantage of limiting regulatory discretion. When compliance depends on infrequent monitoring and the stakes are high, up to the very existence of a firm, both parties may have strong incentives to bend the rules. In some settings, we know that firms engage in local negotiations with private regulators directly. Evidence also indicates that enforcement of environmental policies can be highly sensitive to budgets and macroeconomic goals. In Brazil, evidence suggests that pursuit of economic goals, in particular related to stabilization and economic growth, may decrease enforcement of environmental policies, though this variability may be counteracted by public prosecutors. Relying upon “public civil action” clauses, prosecutors can take individuals, firms, or governments to court in order to force violators to change or halt behaviors. In this setting, Mueller (2010) shows that the strength of the prosecutor is positively correlated with environmental outcomes. This evidence suggests that firms’ ability to negotiate with prosecutors may matter in the enforcement of environmental regulations.

2. The Workshop

The 2012 San Servolo Workshop “Industrial Pollution, Regulation and Growth: Governance Challenges and Innovations” was convened to discuss these challenges and identify areas of potential innovation in environmental regulation. This workshop was part of the annual Executive Session on Grand Challenges of the Sustainability Transition, now in its sixth year, which is a joint undertaking of the Sustainability Science Program at Harvard University and Venice International University (VIU) with support from the Italian Ministry for Environment, Land and Sea. The Workshop was organized by a steering committee co-chaired by Corrado Clini, Minister of Italy’s Ministry of Environment, Land and Sea and Rohini Pande, Mohammed Kamal Professor of Public Policy, Harvard Kennedy School of Government. The 2012 Workshop was led by Evidence for Policy Design (EPoD), a research program at the Center for International Development, Harvard University.
3. Major Themes of the Workshop

The remainder of this report summarizes the main ideas that came from the workshop through the presentations and discussions among the participants while at San Servolo. Five major themes emerged on how to best design and implement effective environmental regulation: (1) maintain a long-term, forward-looking view; (2) engage multiple stakeholders; (3) have at hand, not one regulatory method, but rather a “basket” of techniques; (4) use smart data collection as a tool to improve environmental quality; and (5) use forms of regulation, such as market-based instruments, that account for the costs of enforcement and abatement that regulation imposes. We discuss each of these themes in detail below.

3.1 Forward-looking Regulation

Many developing countries today suffer from severe local environmental stresses. The experience of rich countries shows that, while addressing environmental concerns can be delayed, the significant health and environmental costs imposed by high pollution levels means they cannot be ignored in the long run. If the recent rapid growth in countries such as India and China continues as predicted, the most important policies for the state of the environment in 20 years will be those policies adopted now towards new growth of industry and infrastructure.

A long-term view of regulation needs to emphasize the importance of the regulatory process and structure. For example, how new industrial projects are proposed, cited and reviewed may be very important for long-term urban environmental quality. The structure of national institutions and responsibility for environmental regulation will also be important for guiding sustainable growth.

A couple recent examples from the conference show the importance of regulatory structure in the long run. In Chile, the pioneering particulate matter emissions trading program was placed under the supervision of the Ministry of Health, on the basis that particulates are a public health problem. In practice, however, operating and enforcing a trading scheme is a matter of regulating industrial plants, which is outside the expertise of the Health Ministry and has led to some issues in the program’s implementation. In Brazil, under the leadership of the governor of São Paulo, the São Paulo State Environmental Agency (CETESB) was completely overhauled in 2009, from staffing to regulatory structure. The organization appears much stronger and more efficient than before despite the difficulty of the short-term transition, which involved firing many state employees. These purposeful reorganizations may benefit the environment in the long run by aligning institutional goals and capabilities with environmental objectives.

3.2 Multi-stakeholder Engagement

Private firms and citizens often possess knowledge, resources, and motivation beyond what regulators alone can provide. Consequently, there are major advantages to structuring regulation to leverage the advantages of every stakeholder—not just government and industry—in order to improve environmental quality while containing costs.

Growth depends on the productivity and employment of industry. Clumsy or arbitrary regulation can impede growth, while smart regulation enables industry by taking into account the industrial processes. The cost structure of smart regulation both supports growth and makes it possible to set more ambitious environmental targets by gaining cooperation from industry. In creating an enabling environment for business while retaining environmental goals, it is important to remember that industry’s primary focus is on managing the bottom line and maintaining a client base. Thus, regulators must align industry interests with environmental goals. Instituting economic incentives for industry and/or third-party stakeholders to achieve standards is one approach that appears to be effective. Traditional command-and-control regulations, which set
emission limits for firms and enforce them with fines, feature only sticks (punishments) and not carrots (benefits). Restructured regulations can provide carrots, such as relaxed monitoring regimes or licensing requirements for firms with exceptionally good environmental records, that induce even compliant firms to make greater improvement.

An enabling environment is a stable one, providing firms with certainty about future regulatory requirements and uniformity, reducing free-riding. In such an environment, industry can be brought on board and compliant firms can even support environmental regulation if they do not believe that compliance places them at a disadvantage with respect to other firms that continue violating. Ensuring these characteristics requires highly trained and expert regulators, and a system to disseminate knowledge to industry leaders on how to operate sustainably.

For certain high-profile firms, voluntary disclosure programs—in which pollution outputs are made transparent as a means to improve public relations—can increase cooperation and engagement among stakeholders. The practice of governments defining regulatory goals in concert with industry is another way to increase such engagement. The effectiveness of voluntary compliance programs requires preexisting background pressure for emissions cuts and design features that leverage these pressures, e.g. quantified baselines and targets, transparency, monitoring, and penalties for noncompliance. The benefits of such programs are that they fill in gaps in environmental management capacity and contribute to capacity building in regulation. Informational programs should be complementary to more traditional forms of regulation, as there is inconsistent evidence of the impact of these programs.

If civil society, industry, and media see the need for sustainability, they can drive this agenda. Civil society can provide regulators with local information, and in some cases, can move industry toward higher environmental standards through consumption choices. Meanwhile, the media can act, often through transparency initiatives, to involve the public, another essential stakeholder. However, systems need to be in place to ensure the accuracy of the information that is spread by the media. In addition, both industry and civil society must trust the government regulatory system in order for sustained participation to ensue.

A holistic view of environmental policy links regulation to environmental goals and draws on natural constituencies to see that regulations are enforced. Regulating only at the level of the source of pollution—the industrial plant—may neglect the aggregate impact of an economic activity on the environment. For example, many industrial estates are so densely settled with industry that even firms compliant with emissions norms could collectively cause pollution to exceed ambient standards. Conversely, an isolated plant may show lower damages from its emissions and could be subject to relaxed standards. Holistic regulations that encompass the whole of an area, sector or industrial supply chain can direct regulation towards explicit environmental goals, such as a clean river or a maximum level of ambient air pollution. This holistic approach has natural constituencies for environmental enforcement in the local population, or in the buyer of product, in a supply chain, that can help see that holistic regulations are enforced. The strength of these constituencies will vary by industry. The main challenge in adapting regulations in this way is not allowing discretion and environmental targets to permit undue lenience with respect to individual sources. Market-based instruments with an area-wide cap achieve this balance through a single, transparent price on emissions.

### 3.3 A Basket of Regulatory Techniques

Regulatory tools need to be adapted to match the diversity of the pollution sources being regulated. The conference considered such tools as command-and-control regulation, Environmental Impact Assessments, lifecycle and ecosystem analysis, market-based instruments and voluntary disclosure programs. Each of these has a place in smart environmental regulation,
and the challenge to regulators is to define the domain of each and ensure they complement each other.

The most basic and traditional tool is command-and-control regulation, in which states directly limit firms’ pollution outputs, and enforce these limits with fines or criminal sanctions. This technique does nothing to reduce abatement costs or promote innovation, but will remain the best choice to control certain toxic pollutants and some source types.

Market-based instruments seek to turn pollution into a cost for industry, thus providing an incentive to lower output. One market-based instrument that has had notable success is an emissions trading system, where the regulator sets a cap on total emissions then allows firms to bid against each other for permits to emit portions of that whole. Market-based instruments are a leading example of area-based policies, at the level of the airshed or watershed, that tie environmental regulation directly to environmental outcomes. For example, the sources included in the Chilean particulate trading program are deliberately chosen as major contributors to pollution in the Santiago airshed. At their best, market-based instruments can be a win-win proposition in terms of costs and environmental outcomes. The economic theory underlying emissions trading is sound and therefore in cases where the underlying assumptions are met and logistical and practical implementation issues are solvable, a trading program can work very well. The US experience with trading in the sulfur oxide markets is an example: it has surpassed expectations both in terms of costs and performance, reducing acid rain.

Adapting market-based instruments to the institutional environments of developing countries is a challenge. Market-based instruments require completely transparent measurement of emissions and enforcement of permit holdings to create demand for permits and keep emissions under the cap. Such transparency and uniformity has not been the hallmark of environmental enforcement in developing countries to date. Sources in developing countries may also be smaller and more dispersed than in developed countries, which would raise monitoring and transactions costs. These challenges warrant close attention to regulatory design in bringing market-based instruments to wider use in the developing world.

In assembling regulatory tools, it is important to note that some firms respond to reputational costs, others respond to direct regulation and still others to financial incentives. Each source and environmental problem is different and the same set of incentives or tools may have different effects in different areas. For example, public disclosure may be more effective for industries that sell overseas or have a prominent public role. Similarly, voluntary disclosure programs may have big effects on large, branded companies with a public face but no effect on their smaller firms. Working on a pilot basis with different environmental tools can provide evidence on what regulation works in each situation and why.

In designing regulation, we must beware of regulatory fatigue—the desire to shift to something new rather than improving an existing, and possible ineffective, program. Many programs, including disclosure programs and the cluster approach of area-specific environmental infrastructure and standards, are responses to some existing regulatory failure and have been tried in some manner before. With an eye on the long-term, regulatory design should heed lessons from history so as not to leap from one fad to another. Pushing entirely new regulatory models may neglect chances for incremental improvements within existing programs. The appropriate regulatory tool in each case must bring into balance the harm the pollutant in question poses to society and the likely impact of regulation on firm costs and compliance.

3.4 Smart Data Collection as a Tool to Improve Environmental Quality

Data collection has multiple purposes: to measure the health or environmental consequences of pollution; to determine firms’ compliance with existing regulatory standards and set new
standards and policies; to benchmark environmental performance and communicate to regulators and industry the latest in environmental performance and technological development; and to enable regulatory tools through trading, allocation of permits, pollution charges, etc. The credibility of data is vital to enlist industry and the public in supporting environmental goals, and currently the quality of data in many sectors worldwide is poor. To enforce existing regulation and effectively design new policies, high-quality data is needed, especially data that allows regulators to understand the benefits of environmental standards. The ability of regulators to collect reliable information on the health outcomes associated with various levels of pollution control will greatly improve their ability to set standards, and to compare benefits with costs.

On the industry side, data can be used to evaluate compliance costs associated with different technologies. Furthermore, broad disclosure of this information can help regulators or industry to benchmark environmental performance, in order to identify lowest cost options for environmental performance and target technological development. Subject to the goal of improved public health and its attendant environmental targets, regulators should allow industry the maximum possible flexibility in the means of abatement. The goals of regulation, the desired results, should be specified clearly and kept steady over time. This hands-off, outcome-centered approach is only possible if the outcomes of interest are measured reliably.

The entire process of regulation must be geared to use data for the end of improving environmental quality by giving steady, high-quality feedback to regulated sources. Better monitoring is necessary both to track the evolution of sustainability outcomes of ultimate interest as well as the contribution of different sources to these end goals. New monitoring technology such as continuous emissions monitoring systems (CEMS) are making it possible to deliver accurate data directly to the regulator or, in some cases, the public. However this and other types of monitoring cannot function in isolation; the type and quality of data collected depends on the nature of compliance and enforcement programs. Indemnification, holding industries harmless for the contents of their reporting, may encourage broader sharing of data from industry, but at the expense of limiting the potential use of that data. Because monitoring and data collection requires the cooperation of stakeholders, it is also important to communicate why information is sought and how it will be used. Communicating this will also assist in the enforcement of data use plans. Capacity matters, on the part of both industry and regulators. Environmental technologies, particularly those for monitoring pollution, are not useful without competent human resources to design and implement systems, so it is crucial to build technical capacity through training. Once high quality monitoring is instituted, regulated sources can be granted more flexibility. For example, if the carrying capacity of an area is well estimated and measured, then the extent of activity within that area need not be otherwise constrained.

It is important to pay attention to scope when interpreting data: does the data reflect one firm, a cluster of firms, or an entire industry? When conducting Environmental Impact Assessments on mines, for example, a particular project may have an impact on many aspects of the environment and may itself be only one part of a larger pattern of economic activity that determines environmental outcomes, such as a mining cluster. Collecting data and permitting activity at a broader level than the individual project may therefore protect the environment better and lower the costs of preparing a quality report. In such an area-wide or cluster-wide approach, monitoring of ambient environmental outcomes, societal indicators and overall activity becomes essential.

Data quality is not an end or its own department but a means towards better regulation. Regulation in developing countries often focuses on inputs rather than environmental outcomes such as air and water quality and other sustainability indicators including impacts of local communities. The focus of regulation should be on end outcomes, not inputs. Whether using cluster-based approaches, market instruments or some other form of regulation, the first priority
is accurate monitoring of pollution emissions and ambient environmental quality. While regulation necessarily focuses on what regulators are able to measure, a focus on information should not detract from the goal: improved health and longer lives through better ambient environmental quality.

3.5 Use Regulation that Accounts for Costs
Regulation is a hierarchy and the appropriate regulatory tool should be based on cost-benefit analysis. Piloting innovative regulatory regimes will be helpful. These may include regionally targeted market-based programs, technologies and systems exploiting economies of scale, and cooperative and voluntary schemes. The appropriate form of regulation will trade the costs of the regulation—including abatement costs, monitoring and enforcement—against the damages caused by a particular pollutant.

For high-priority environmental problems with significant health effects, high-cost continuous emissions monitoring systems are warranted and should be installed wherever possible, e.g. for the monitoring of ambient air quality or mega-sources. Monitoring of inputs can be lower in cost in some situations, for example, with certain basic industries or industries where an important determinant of pollution is raw materials such as agricultural chemical applications. Beyond this base of monitoring, voluntary disclosure programs can release a wide amount of information at a low cost. The effect of such programs will depend on whether the firm in question has reputational concerns. Information release may be directly effective in encouraging compliance among large firms, but for small firms, identifying best practices and technological improvements are the more likely channels for information sharing to work effectively.

Developed and developing countries alike find themselves constrained in how much direct monitoring of industries is possible. In order to overcome this problem, it is important to institute complementary incentives to both release information and reduce pollution. For example, in many developed countries firms face steady monetary costs for emitting and, at the same time, steep criminal sanctions for falsifying environmental data. This structure encourages both accurate reporting and abatement.

Achieving these two ends at the same time is not straightforward. For example, it may be difficult to impose high penalties for noncompliance because such penalties lead to misreporting, and it is impossible to impose high penalties for misreporting without a measure of the truth. Therefore robust solutions to measure pollution accurately—through technology or overlapping systems of third-party and regulatory scrutiny—may be a prerequisite to introducing stronger incentives for pollution reduction. Information is not a fixed set of knowledge on which to base regulation, but will itself change with regulatory incentives for reporting. In particular, regulated firms have no incentive to report information that will make their project more difficult to start or their business more costly to run. Regulation must establish incentives for accurate reporting by third parties or firms themselves.

Market-based instruments are powerful as a means of explicitly accounting for environmental benefits and regulatory costs. Setting a single cap or tax fixes the government’s view on the value of reductions for a particular pollutant. Reducing regulatory discretion and making the cost of pollution emissions as predictable as the power bill can make regulation more reliable. While all regulatory programs should balance the costs and benefits of regulation, market-based instruments are favored (where they can be applied) for making this trade-off transparent and passing the appropriate social cost of pollution directly to firms.
4 Participants in the 2012 San Servolo Workshop

Co-Chairs:
Dr. Corrado Clini (Italy) Minister, Ministry of Environment, Land and Sea
Dr. Rohini Pande (USA/India) Mohammed Kamal Professor of Public Policy at Harvard Kennedy School, co-director of Evidence for Policy Design (EPoD) at the Center for International Development, Harvard University

Participants:
Mr. Chandra Bhushan (India) Deputy Director General of the Centre for Science and Environment (CSE)
Ms. Claudia Blanco-Vidal (Chile) Assistant Professor in Economics, Universidad del Desarrollo
Mr. Carter Brandon (China) Lead Environmental Specialist for the World Bank in East Asia and the Pacific
Dr. Chandra Shekhar Dubey (India) Professor of Earth and Environmental Sciences and head of the Department of Geology, University of Delhi
Mr. Deep Kapuria (India) Chairman of the Hi-Tech Group of Companies
Mr. Rafael Lorenzini (Chile) Executive Director, Chilean Clean Production Council
Dr. Brian J. McLean (USA) Former Director, Office of Atmospheric Programs, U.S. Environmental Protection Agency (EPA)
Dr. Ligia Noronha (India) Senior Fellow and Director of the Resources, Regulation and Global Security Division at the Energy and Resources Institute (TERI), India
Dr. Fernando Rei (Brazil) Professor of Environmental Law, Armando Alvares Penteado Foundation, São Paulo; Assistant Professor in the Doctoral Program in International Environmental Law, Catholic University of Santos (Unisantos)
Dr. Flávio de Miranda Ribeiro (Brazil) Mechanical Engineer, São Paulo State Environmental Agency
Dr. Jeremy Schreifels (US) Senior Environmental Protection Specialist, Office of Air and Radiation, U.S. Environmental Protection Agency (EPA)
Ms. Valsa Nair Singh (India) Secretary of the Department of Environment, Government of Maharashtra
Mr. Weishan Yang (China) Chinese Academy for Environmental Planning (CAEP), Beijing, Institute of Policy Management of Chinese Academy of Sciences
Dr. Jinhua Zhao (US/China) Professor of Economics and the Director of the Environmental Science and Policy Program, Michigan State University; special term professor, Shanghai University of Finance and Economics

Additional Moderators/Organizers:
Ms. Deanna Ford (USA) Associate Director of Evidence for Policy Design (EPoD) at the Center for International Development, Harvard University
Mr. Nicholas Ryan (USA) Massachusetts Institute of Technology
Dr. Anant Sudarshan (USA/India) Harvard Kennedy School; Senior Research Manager, J-PAL South Asia at IFMR.
5 Summaries from the Workshop Sessions

Opening Remarks and Introductions
Ambassador Umberto Vattani, VIU President
Rohini Pande, Mohammed Kamal Professor of Public Policy at Harvard University,
Rapporteur: Anant Sudarshan

Opening remarks highlighted the extended history of collaboration between VIU, the Italian Ministry of the Environment, Land and Sea and Harvard University. It also pointed to the value of evidence-based design of policy innovations. For the introductions, participants were invited to identify and comment on where they saw potential for piloting new ideas in one of the following areas related to their work: a) monitoring innovations, b) regulatory innovations, or c) participatory innovations.

Initial reflections were shared on a variety of topics, including:
- Better data collection and monitoring in developing countries
- Pragmatic approach in choosing regulatory tools, rather than a dogmatic focus on one type of tool
- The need to train regulators on an ongoing basis
- Designing incentives and regulation that explicitly recognize impacts on communities and social networks—i.e. human security
- The need to link sustainability to business outcomes, particularly among small and medium sized enterprises, in order to enable willing industry participation fully in environmental programs
- The challenge of “green growth,” particularly in India and China, and how it can facilitate the transition from middle income to high income status

5.1 Session 1: Environmental Pollution in the Developing World
Moderated by Rohini Pande, Harvard Kennedy School [see slides]
Rapporteur: Nicholas Ryan

5.1.1 Purpose of the session

Pollution levels in developing countries are very high by many measures, from suspended particulate matter in the air to heavy metals in the soil. While industrial development is important for growth, it also leads to serious health and environmental concerns. Monitoring is a key challenge in quantifying these problems and tracing them to their sources. Monitoring systems need to prioritize amongst environmental problems and create clear environmental accountability to enable regulatory action.

In this session we aimed to:
- Identify a set of common environmental pollutants caused by industrial processes, focusing on the most pressing of these problems in developing countries today, and to pinpoint gaps in information regarding sources.
- Generate ideas on how to design holistic monitoring systems, which create accountability by relating pollution at sources to ambient environmental quality.
5.1.2 Discussion points

Introductory remarks were shared on pollutants in the developing world, their health costs, and the possibilities of controlling them through monitoring and regulations. Air pollution, especially fine particulate matter, can lead to higher rates of heart disease, lung cancer, and other respiratory and cardiovascular illnesses. Research indicates a causal link between air pollution and labor supply and productivity. Acute and long-term exposure to water pollution can also lead to poor health outcomes, though identifying a causal link is difficult.

Given these known pollution costs to society, the role of effective monitoring in quantifying pollution and tracing it to its sources was emphasized. Governments should aim to regulate important pollutants at the levels and in the areas where they cause harm, and to design holistic monitoring and accountability mechanisms that create trust and firm willingness to participate. In doing so, governments must remain cognizant of the central trade-off in designing regulation—balancing the costs of more expansive monitoring systems with the risks that under-regulated pollutants pose to public health.

The ensuing discussion highlighted the challenges in regulatory design and implementation when accurate data is largely nonexistent or unavailable. Poor pollution and cost estimates when introducing regulation creates the opportunity for renegotiation by industry leaders and rent-seeking on the part of corrupt officials. Without data, it is difficult to benchmark appropriate goals. Subsequent monitoring is also important to evaluate the effectiveness of the regulation.

The group agreed that accurate monitoring, effective penalties or rewards, and consistent enforcement are key components of successful regulations across all pollution control programs. Performance-linked incentives may lead to better monitoring.

Finally, the group also addressed the role of voluntary disclosure programs in environmental regulation. Disclosure may put industry or government at risk of lawsuits. Such programs therefore need to be designed with an appropriate legal context so that firms know how disclosed data may be used and what liabilities they may assume in disclosing noncompliance.

5.1.3 Take-away points

A. Regulation should be forward-looking.
   - In developing countries with rapid growth, the most important policies for the state of the environment in 20 years will be those adopted now towards new growth of industry and infrastructure.
   - In some areas, differentiating between the “old way” and the way new projects are regulated may help to establish environmental principles, such as a clear chain of responsibility for ambient environmental quality. This change must not allow neglect of enforcement of legacy regulation.

B. Focus on end outcomes.
   - While regulation necessarily focuses on what regulators are able to measure, focus on measurement should not shift attention away from the goal of improved health and longer lives through better ambient environmental quality.
   - Subject to this goal and its attendant environmental targets, regulators should allow the maximum possible flexibility in the means of abatement. The goals of regulation, the desired results, should be specified clearly and kept steady over time.
C. Regulation should leave scope for upside.
Many command-and-control regulations have punishments for noncompliance but not rewards for outperformance. Restructured regulations can provide even compliant firms incentives for greater improvement.

5.2 Session 2: Extending Regulatory Capacity throughout Society

Moderated by Deanna Ford, Harvard Kennedy School [see slides]
Rapporteur: Anant Sudarshan

5.2.1 Purpose of the session

Traditional environmental regulation often overemphasizes the role and responsibility of governments, even though industry and civil society can and should be involved. Alone, the government has limited capacity and information regarding industry compliance costs, as well as limited knowledge regarding the merit of local civil society concerns. Integrating the knowledge and resources of these parties through innovative regulation—including market-based instruments, information disclosure, and participatory monitoring—can lead to improvements in environmental performance.

In this session, we aimed to:

- Review strategies for extending regulatory capacity throughout society, and to identify new ways of incorporating private industry and civil society in ways that draw on their unique strengths.
- Evaluate specific policy designs, such as improved transparency and participatory monitoring, that have the potential to increase civic engagement and reduce pollution.
- Consider formal and informal mechanisms that increase transparency and civic and private sector engagement. In particular, to consider whether regulators can design incentives for private parties to report and abate pollution on their own accord.

5.2.2 Discussion points

The session was opened with a brief presentation on the challenges in environmental regulation in developing countries, including poor availability of information, difficulty in consolidating political will, constraints in governments’ ability to monitor and enforce regulations, and the abundance of small and informal firms which are especially difficult to monitor. This introduction highlighted the idea that government, industry and civil society may together facilitate successful environmental regulations, yet transparent information and trust are crucial. As components of this, governments should implement mechanisms for ongoing feedback from industry and civil society, introduce regulatory structures that encourage transparency, and align firms’ profit goals with regulatory goals. Industries have the best knowledge of their processes and abatement costs, yet typically have little interest in undertaking rigorous pollution control independently. Hence, committed industry-wide involvement in regulation, as well as formal mechanisms for public feedback, may induce greater compliance.

The discussion began by considering the role of the private sector in diffusing technology across the world. As technologies spread, environmental performance is not guaranteed. Management of technologies matters: one country may have the same technology but manage and implement it differently than another, leading to differing environmental performance. Furthermore,
monitoring is not an end in itself and regulation must build feedback mechanisms that link monitoring results to changes in action. The group acknowledged that a central challenge for emerging economies remains to be how to involve the private sector in environmental regulation.

A participant followed this discussion stream with the point that governments can facilitate and encourage “green growth” within the private sector. Within fast-growing economies, green technologies and products can provide win-win gains through improved environmental outcomes, as well as lower costs and better consumer value.

Another concern raised by participants was the ability to attract, train, and equip high-quality regulators. One participant identified waste management as an area where sufficient data exists, yet there is too little training of regulators on how to use that information. This challenge is similar to that of managing technologies raised above: technologies are only as useful as the capacity of regulators to leverage them.

The conversation then transitioned to the role of the civil society in monitoring environmental outcomes. Activating civil society’s role in regulation increasingly involves the media, which has the power to spread information broadly and rapidly. How can this information be harnessed to improve environmental compliance, rather than pit civil society and industry against each other? How should industry prepare for and respond to potential class-action lawsuits? One participant commented that public opinions drive political will, and thus the use of media to inform the public can serve to motivate political and industrial action. Other ways to raise awareness of environmental problems were presented, including devoting a mandatory minimum percentage of budgets to the environment, making training mandatory for industry, establishing green tribunals and green buildings, and making school children do projects on local environmental problems.

Two examples of public disclosure programs were then briefly discussed: pollutant release and transfer registries, and performance evaluation and ratings programs (PERPs). The benefits of these types of programs include that they do not depend directly on regulatory enforcement, and therefore can be less expensive and broader reaching. However, the scant body of existing empirical evidence in developing country settings suggests that their influence of actual firm behavior is limited to increasing performance of the worst-rated plants, and that better performing plants do not change behaviors. One participant drew upon his experience with public disclosure in India sharing that every sector rated among the worst-performing firms improved. The group then discussed potential criteria for successfully functioning disclosure programs, and identified the need for credibility of the disclosure outlet. It was also noted that a firm’s share of the market must be impacted in the short run after the release of ratings, for a link to be considered causal. With an average of less than one inspection per year per industry, emerging economies may require more frequent monitoring and disclosure to have an impact on market perceptions and induce change.

The discussion turned to policies and programs that prompt polluters to voluntarily commit to emissions reductions. The effectiveness of voluntary compliance programs requires preexisting background pressure for emissions cuts and design features that leverage these pressures, e.g. quantified baselines and targets, transparency, monitoring, and penalties for noncompliance. The benefits of such programs are that they fill in gaps in environmental management capacity and contribute to capacity building in regulation. Currently, one drawback is that there is inconsistent evidence of the impact of these programs.

A presentation was given on the successful experience of the Clean Production Agreements (or CPAs) in Chile, which demonstrated that voluntary programs constitute an effective tool for
implementing changes towards sustainability and are beneficial for the productive sector as well as for society [see slides]. This type of regulation requires a public-private scheme or philosophy, as well as monitoring and assessment by independent third parties (as in Chilean case). Chile relies on cooperative technical assistance partly because, unlike India, the government disallows direct capital subsidies. This approach is therefore more labor-than capital-intensive and may encourage abatement by lowering operating costs.

A.2.3 Take-away points

A. Civil society, industry, and media see the need for sustainability and can drive this agenda. Civil society can provide regulators with local information, and in some cases, can move industry toward higher environmental standards through consumption choices. Need ways to ensure accuracy of information that is perpetuated through media.

B. Capacity matters, on the part of both industry and regulators. Environmental technologies, particularly for monitoring pollution, are not useful without competent human resources to design and implement systems. Building technical capacity through training is crucial.

C. Monitoring does not live alone.
- The type and quality of data collected depends on the nature of compliance and enforcement programs. The intended and permitted uses of data should be specified clearly.
- Credibility of data is vital, and the present quality of data in many sectors is poor.

D. Voluntary programs can work if incentives also exist. Improving environmental outcomes must be valuable to the private sector as well as the public sector. Environmental compliance must be built into private sector profit goals.

5.3 Session 3: Balancing Environmental Quality and Growth

Moderated by Brian McLean, US EPA (1972-2010)
Rapporteurs: Nicholas Ryan and Anant Sudarshan

5.3.1 Purpose of the session

Command-and-control regulations run the risk of being blunt and costly in some cases, and increase the risks of disrupting economic activity. Depending on the nature of the pollutant, its degree of mixing, and the types of sources, regulation may be often be improved through mechanisms, such as market-based instruments, that reveal abatement costs of different sources and allow firms flexible means of reducing costs, while ensuring that local ambient environmental quality is maintained.

In this session, we aimed to:
- Discuss the trade-off between short-term growth and environmental regulation, and how sound policy can minimize costs associated with this trade-off.
- Explore strategies to improve environmental quality while sustaining growth.
- Consider the trade-off between command-and-control systems that better account for costs, and market-based instruments that allow for industry choice of abatement strategy.
5.3.2 Discussion points

In opening comments, moderator Brian McLean said that if we grow, get rich and then try and play catch-up after the fact and clean up, then we ultimately pay more and we create an “artificial” divide between growth and environment. If this is the case, then how do we grow and actually harness that growth towards cleaner air and water?

The conversation began with a discussion of industry growth and costs. One participant made the point that growth is not a given, and is instead something for which industry needs to strive. Growth facilitates job creation, which is perhaps the greatest challenge for emerging economies. Thus, in this view, the best action governments can take is to create an enabling environment for industrial growth. Another participant suggested it is unlikely that original equipment manufacturers are interested in greening their supply chains. Furthermore, regulation can simply move pollution to different locations; thus, even if the first tier gets greened, often the process just moves down to second and third tier. Responding also to discussions from the prior session, a participant noted that firms will also be unlikely to disclose information unless there is zero liability. Another useful comment was made that it is necessary to link pollution to waste management and production efficiency within firms, and therefore a push from the top of the supply chain may help.

To add to the conversation, a presentation was given on industry perception of innovation regulatory efforts in São Paulo, Brazil [see slides], which suggested that regulatory innovation occurs, but not as a consistent planned strategy. In the Brazilian context, differences in regulatory capacity between states endanger local advances, enabling industry to relocate activities to pollution havens. Furthermore, industry does not always perceive regulatory advances as innovative or trust the government’s “good intentions.” This limits collaboration and strategic partnerships, generates reactive responses, and hinders the use of some instruments. Some enterprises want regulation—presumably these are the over-complying firms wishing to reduce competition. Limited enforcement capacity creates a risk of “free-riding” and diminishes industry confidence to invest in improvements. Instead, the need for targeted enforcement, monitoring, reporting and disclosure requirements was emphasized. Reliable data is missing and rarely disclosed, even at major industries. Some regulatory advances face practical barriers at the local market including lack of providers, counterproductive administrative mechanisms and tax, etc.

In the discussion that followed, several ideas were raised. One participant suggested that some industry will respond to reputational costs, others will respond to regulation, and still others respond to financial incentives. Can environmental management encompass all types of regulation? Another participant built on this idea, speaking of the importance of cluster level versus supply chain level approaches. In addition, one individual raised the question of whether, from an efficiency standpoint, governments should pay for information or incentivize voluntary disclosure.

5.3.3 Take-away points

A. Create an enabling environment for business while retaining environmental goals.

- Smart regulation that takes into account the industry process and cost structure both supports growth and makes more ambitious environmental targets possible by gaining industry cooperation.
• An enabling regulatory environment is both stable and uniform. Industry can cooperate and even support environmental regulation if they do not believe that compliance places them at a disadvantage with respect to other firms that continue violating.
• Ensuring desirable regulatory characteristics (stability and transparency in rules and penalties, a common understanding of purposes and best practices) requires highly trained and expert regulators.

B. Productivity is an environmental policy.
• Reliability of power, quality of transport infrastructure and other public goods can improve environmental outcomes greatly though they are not part of traditional environmental policy. For example, without reliable power, industry must use less-efficient, smaller-scale generation themselves that contributes to local air pollution.
• Industry has a natural interest in environmental policy in the sense of reducing waste in raw materials, fuel, water and other inputs. Environmental policy can be made more effective by focusing on reducing wastage and therefore industry cost.

C. Regulation requires a holistic focus.
• Regulation at the source level for a select number of sources, based on size, location, or other characteristics, may shift environmental problems around rather than properly controlling them.
• Holistic regulations that encompass the whole of an area, sector or industrial supply chain may therefore be more effective in achieving environmental goals. The area, sector, or supply-chain approaches have natural constituencies for environmental enforcement in the local population or the buyer of products. The strength of these constituencies will vary by industry.

D. A basket of regulatory approaches will be most effective.
• The regulatory approach must incorporate the regulator, industry and citizenry, rather than a bilateral regulation between the regulator and industry only.
• Each source and environmental problem is different, and the same set of incentives or tools may have different effects in different areas.
• Conducting pilots of different environmental tools can provide evidence on what regulation works in each situation and why.

5.4 Session 4: Innovative Regulatory Techniques – Market-Based Instruments

Moderated by Brian McLean, US EPA (1972-2010)/[see slides]
Rapporteur: Anant Sudarshan

5.4.1 Purpose of the session

Market-based instruments may provide opportunities for more cost-effective pollution control and a clear, transparent structure for monitoring and enforcement. These instruments also provide firms with the largest pollution abatement costs the ability to transfer abatement to firms with lower costs. There are particular challenges, however, for designing and implementing effective market-based regulation in developing countries. While there may be high returns to using market-based instruments such as emissions trading in low-income countries, their viability depend strongly on monitoring capacity and political will. There may be other reforms that are necessarily higher priority.
In this session, we aimed to:
- Discuss the use of market-based instruments in environmental regulation.
- Reflect on the implementation capacity of governments and industry with respect to market-based instruments.
- Share experiences on regulatory programs that have meaningfully reduced pollutant emissions and discuss additional challenges in developing countries.
- Identify obstacles to the adoption and functioning of these instruments, and evaluate the role international knowledge-sharing can play.

5.4.2 Discussion points

The session began with an overview of market-based emissions programs and their success in the US. The Acid Rain Program has had virtually 100% compliance, its administration requires less than 50 people, and the compliance cost a quarter of initial estimates. Properly designed and applied, cap-and-trade regulation has three principal benefits over traditional regulation. First, it provides greater certainty that emissions will be controlled and that health and environmental benefits will be achieved through its mass emissions cap covering all affected sources. Strong emissions monitoring and reporting, transparency, and predictable consequences for non-compliance further help programs achieve the cap. Second, it provides lower costs to industry, government, and society to achieve a given level of benefits through the compliance flexibility that allowance trading provides firms, as well as through the incentives for innovation and for exceeding minimum standards. Third, it leverages private financial and human resources in pursuit of more effective and lower cost controls, making further emissions reductions feasible and promoting sustainable development.

The session then turned to an emissions trading scheme in Santiago, Chile [see slides]. Although there were some weaknesses in its implementation, the system resulted in significant emissions reductions in the industrial sector (over 90% particulate matter and 50% NOx) and allowed the industrial sector to grow without an emission increase. Challenges with the system included weaknesses in the implementing institutions (no dedicated agency to operate the program, insufficient staffing for verifying emission measurements); weaknesses of the emission measurement system; complexity of the system’s design; high costs of transactions, including finding willing buyers/sellers; and lack of clear long-term policy signals to provide certainty for enterprises resulting in a preference to hold excess permits because it isn't clear how much they will need to reduce in the future. This provides a valuable case for study and lessons for future application.

5.4.3 Take-away points

A. Previous experiences and new pilots—both successes and failures—can provide valuable lessons for countries designing regulation.
- The Chilean experiment with particulate matter trading has helped to inform future programs in their country. The lessons learned are also reflected in the choices made by the proposed Indian program in particulate trading as well.
- Piloting—with the intent of learning and as evaluation of new ideas—may be beneficial as part of regular practice and on an ongoing basis. Such pilots can lead to improvements in program effectiveness.
B. At their best, market-based instruments can be win-win in terms of costs, environment, and innovation.
- Market-based instruments are a leading example of area-based policies, at the level of the airshed or watershed, that tie environmental regulation directly to environmental outcomes.
- The economic theory underlying trading is sound and therefore in cases where the underlying assumptions are met and logistical and practical implementation issues are solvable, a trading program may work very well.

C. However, in an emerging economy setting, market-based instruments may run up against institutional constraints.
- Monitoring, transaction costs, regulatory capacity, coverage of sources and, crucially, monitoring technology are major challenges for emerging economies.

5.5 Session 5: Innovative Regulatory Techniques – Data and Technology

Moderated by Anant Sudarshan, Harvard and J-PAL South Asia
Rapporteur: Nicholas Ryan

5.5.1 Purpose of the session

In theory, better monitoring technology and systematic data collection can improve regulatory outcomes by providing regulators with more accurate and consistent information. Continuous emissions monitoring systems (CEMS), for example, can provide regulators with comprehensive information, and such technology is becoming increasingly less expensive (though costs are still an important concern). New technologies can also enable holistic monitoring systems that create accountability for ambient environmental quality; however, challenges remain in implementing these systems.

In this session, we aimed to:
- Assess existing technologies that are employed to measure industry point source pollution, and to consider their successes and failures from a regulatory and an industry perspective.
- Identify promising best practices in monitoring, data collection and technology adoption.

5.5.2 Discussion points

The session started with a presentation on initial learnings from an ongoing evaluation of a continuous emissions monitoring system (CEMS) in India and on the larger pilot emissions trading scheme (ETS) it is part of [see slides]. This monitoring regime aims to rigorously evaluate an ETS pilot in terms of environmental performance and emissions, economic costs/benefits, compliance levels, and ancillary costs and benefits. The pilot relies on a randomized controlled design that allows comparison of treatment and control groups, and will also evaluate the use of CEMS.

The presenter discussed the role of CEMS in addressing the four aspects of monitoring: data (what parameters to collect); technology (how to collect required data); participation (who undertakes monitoring and what oversight exists); and reliability (both technical reliability and the institutional incentives that influence reliability of monitoring). In particular, CEMS can
enhance reliability and provide high quality and transparent data that may then be used to undertake regulatory analysis.

In the discussion that followed, one member share on research of the ETS experience in the EU, and another participant shared about monitoring technologies used in Santiago [see slides].

5.5.3 Take-away points

A. **Data collection is necessary for many reasons:**
   - Determining compliance with existing regulatory standards and setting new standards and policies.
   - Benchmarking of environmental performance, either for regulators or industry to learn about environmental performance and new technological development.
   - Measuring health or environmental consequences of pollution.
   - Enabling trading, allocation of permits, pollution charges or the use of other instruments.

B. **A key focus for regulators should be on methods to maximize the reliability of information on which decisions are made.**
   - This implies exploring the role that technology, institutional structures and stakeholder involvement can play in increasing the accuracy and utility of information.

C. **Regulation is a hierarchy and the appropriate regulatory tool should be based on cost-benefit analysis.**
   - For high priority environmental problems with significant health effects, high-cost continuous emissions monitoring systems are warranted and should be installed.
   - Monitoring of inputs can be lower cost in some situations, such as when raw materials are an important determinant of pollution.
   - Beyond this base of monitoring, voluntary disclosure programs can release a wider amount of information at low cost.

5.6 **Session 6: Innovative Regulatory Techniques – Public-Private Partnerships**

*Moderated by Nicholas Ryan, MIT*

*Rapporteur: Anant Sudarshan*

5.6.1 **Purpose of the session**

Private firms often have skill and resources in environmental management but may not have the motivation to improve environmental outcomes. Regulators can leverage the expertise of private sector firms or nongovernmental organizations effectively through public-private partnerships, though there are practical challenges (discussed below) associated with this approach. In concert with these initiatives, regulatory structures need to give firms incentives for environmental improvements and hold them accountable for failures.

In this session, we aimed to:
   - Assess existing examples of partnerships in pollution control and regulation, and identify models of incorporating civil society and industry in regulatory processes.
• Consider whether public-private cooperation can increase transparency and lower costs.
• Explore how regulators can create feedback loops from civil society and industry into regulatory design.

5.6.2 Discussion points

The session opened with three presentations. The first was on the process of Environmental Impact Assessments (EIAs) in India. While these programs have some benefits, they are limited by the quality of data provided by project proponents and the capacity to use and follow-up on the information that is collected. Without information and technical capacity, consultants are often unable to provide useful EIAs and to develop management plans. The presenter concluded by asking if we can require payments to be made by the polluters.

The second presentation was on the use of sustainability markers for mining regions, which include environmental and social performance indicators, quality-of-life indicators, and adjusted income accounts [see slides]. Stakeholders—identified as community, company, and government—have differing interests which sometimes overlap and often compete; the goal is to create a set of tools and indicators to respond to the stakeholders’ needs to enable a diffused, more participative and transparent regulatory control through society. Income from mining must be measured against the costs in terms of resources, the environment, and health and social costs (as determined by surveys), and the polluter should be required to compensate in each of these areas. The mining firm’s income after these payouts is called the “Impact Adjusted Income in the Mining Region,” and researchers have come up with a system for calculating it.

The third presentation was on the role of private third-party auditors in pollution regulation in India [see slides]. These auditors have a growing place in environmental regulation worldwide, but face conflicting incentives, especially when they are paid by the firms they audit. In a rigorous impact evaluation in Gujarat, India, this conflict of interest was removed by paying the auditors independently and double-checking their reports. The results showed a large impact on auditor reporting. Auditors in the control group (working under status quo regulation) systematically underreport pollution levels, especially just beneath the regulatory standard. Treatment substantially reduced false compliance readings in audit reports. The plant response was to reduce pollution.

The discussion that followed pointed to the need for more rigorous evaluations of this type and the potential to apply the learnings from the study to other contexts.

5.6.3 Take-away points

A. Environmental management requires information—but information can be unreliable for technical and institutional reasons.
• Information is not a fixed set of knowledge on which to base regulation but itself will change with regulatory incentives for reporting.
• In particular, regulated firms have no incentive to report information that will make their project more difficult to start or their business more costly to run. Regulation must establish incentives for accurate reporting by third parties or firms themselves.
• Technical capacity to process and use information may also be a constraint in some cases.
B. Scope of regulation matters.
• A particular project may have an impact on many aspects of the environment and may itself be only one part of a larger pattern of economic activity that determines environmental outcomes.
• Collecting data and permitting activity at a broader level than the individual project may therefore protect the environment better and lower the costs of preparing a high-quality report.
• In such an area-wide or cluster-wide approach, monitoring of ambient environmental outcomes, societal indicators and overall activity becomes essential.

C. Pilots can work.
• The environmental audit program is a case where small modifications on an existing scheme produced measurable results in terms of auditor accuracy and environmental quality.
• This project may be a template for modifying and evaluating other innovations in environmental regulation.

5.7 Session 7: Piloting Regulatory Innovations

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5.7.1 Purpose of the session

Policy design is a continuous process of collecting information, implementing changes, measuring their effects and improving design to increase impact. Piloting can be a useful, structured way to accelerate this process.

In this session, we aimed to:
• Reflect on the learnings from the past two days and identify where knowledge gaps can be filled through pilot experiments.
• Identify ideas or practices that participants believe could be useful in their own countries.
• Identify methods for trying out ideas and testing their effectiveness.

5.7.2 Discussion points

The session began with a presentation on changes made at the São Paulo State Environmental Agency (CETESB) in 2009, how they decided on the change, and how they measured effectiveness [see slides]. CETESB founded its transition to market-based instruments on the strong basis of a well-enforced command-and-control system, and built in partnerships between industry, regulator and university. The governor of São Paulo with the support of the legislature drove the program top-down. They enacted a strong system of permits and licenses and put in place benefits toward cleanup, including rebates on capital equipment and reduced frequency of inspections. They imposed mandates on clean behavior not just on industry but on municipalities as well. The CETESB conducted intense training with a focus on management and new technology, replaced 20% of all employees, and conducted electronic analysis of processes of licensing and approval especially targeted toward small industry.
The group then considered how to apply the themes raised in the discussions in previous sessions to the context of regulating for sustainable development in new industrial clusters. Such state planned industry complexes will be an important part of economic development in India, China and other fast growing economies and therefore it was considered useful to think about how to ensure that we balance the needs of economic growth and sustainability in such developments. In addition, because new industrial complexes provide more of a blank slate, it may be possible to avoid some of the complications that arise from legacy regulatory systems.

In the discussion that followed participants raised the following questions: While it is necessary to build new industry developments taking into account multiple objectives including stakeholder interests and overall goals, how do we do this in a sensible fashion? Can regulators provide a platform for local monitoring and/or outsource certain activities to local communities?

5.7.3 Take-away points:

A. Sustainable development of new industry complexes will require regionally targeted environmental regulation. For example, carrying capacity considerations, the needs of local communities and the requirements of industry must all be considered.

B. Stakeholder engagement is important and therefore regulation must be transparent and stable. Enforcement mechanisms need to established upfront, and the basis for defining compliance should be clear to all concerned.

C. Voluntary disclosure programs and defining regulatory goals in concert with industry can help increase cooperation and engagement.

D. Piloting innovative regulatory regimes will be helpful. These may include regionally targeted market-based programs, technologies and systems exploiting economies of scale and cooperative and voluntary schemes.

E. Regulatory design should beware of regulatory fatigue.
   - Many programs, including the cluster approach and disclosure programs, are a response to some existing regulatory failure and have been tried in some manner before.
   - Regulatory design should be for the long-term and learn lessons from history so as not to leap from one fad to another. Pushing wholly new regulatory models may neglect chances for incremental improvements within existing programs.

F. Regulate outcomes, not inputs
   - Regulation in developing countries often focuses on inputs rather than environmental outcomes such as air and water quality and other sustainability indicators including impacts of local communities.
   - Whether using cluster-based approaches, market instruments or some other form of regulation, the first priority is accurate monitoring of pollution emissions and ambient environmental quality.
   - Better monitoring is necessary both to track the evolution of sustainability outcomes of ultimate interest as well as the contribution of different sources to these end goals.
   - Once high quality monitoring is instituted, regulated sources can be granted more flexibility. For example, if the carrying capacity of an area is well estimated and measured, then the extent of activity within that area need not be otherwise constrained.
References


