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Using Information Disclosure to Achieve Policy Goals: How Experience with the Toxics Release Inventory Can Inform Action on Natural Gas Fracturing

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Introduction

In one of the most striking developments in recent years, the fracturing of shale deposits has transformed the U.S. energy economy by sharply increasing the supply of natural gas and lowering its cost. Shale fracturing, or fracking, also poses significant challenges for state governments as they design and adopt public policies to respond both to changes in the shale gas industry and rising public concern over health and environmental risks associated with fracturing.

This paper focuses on the potential of mandatory information disclosure policies to meet public demands for knowledge of the chemicals used in hydraulic fracturing. It draws from an extensive study of the use of information disclosure in the federal Toxics Release Inventory (TRI) program to illustrate how such policies operate; the effects they have on businesses and the public; the way in which the information is used by public officials; the potential and limitations of such policies; and how they can be designed and implemented in a way that helps to assure their effectiveness.[1]

What is the connection between the TRI program and natural gas fracturing? The TRI program began with a widely shared belief that people have a right to know about toxic chemicals released to the environment that might pose a risk to their health or well-being. Indeed, recognition of this right to know was instrumental in federal creation of the TRI program in the mid-1980s, and in many similar state and local programs adopted during the 1970s and 1980s.

As it operates today, the TRI program mandates that industrial facilities releasing any of about 650 specific chemicals that are above threshold amounts provide that information to state and local governments and through them to the federal government, which compiles the national database. The data are then made available to the public through several Web-based services.

Any opinions, findings, conclusions, or recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Center for Local, State, and Urban Policy

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People living near any of the roughly 20,000 facilities that report to the inventory each year have access to information about the specific chemicals that each facility releases to the air, water, or land, and the amounts that are released each year. For chemicals released to the air, the federal government also provides the information in a manner that permits assessments of public health risks.

Precisely what kind of information disclosure program will work best for the hydraulic fracturing industry remains unclear. Yet by many reasonable standards, the policies adopted to date fall short of what is needed to inform the public of the chemicals in use as well as the health and environmental risks they may pose.[2]

Key Findings

1. Hydraulic fracturing presents the nation, and especially state governments, with some unique public policy challenges. Public opposition to fracturing has risen, especially over concerns of possible contamination of groundwater and surface water with chemicals used in drilling operations. A well-designed disclosure policy can provide the public with the information that it seeks without unduly constraining the industry.

2. Mandatory information disclosure is widely used and broadly supported in the United States today. The federal Toxics Release Inventory is a prime example of such a public policy, and it is has operated successfully since its establishment in 1986. It is the premier example of a non-regulatory federal environmental policy.

3. Such programs respond to a belief that the public has a right to know about chemicals used in industrial operations, particularly in those facilities that are close enough to pose a risk to public health or the environment. Such a program appears to be ideally suited to the hydraulic fracturing industry where states have been reluctant to impose regulatory oversight and where federal action is blocked by public law.

4. In its January 2013 TRI report (covering the year 2011), the U.S. EPA documents a continuing decline in the amount of toxic chemicals released to the air, water, and land. Analysis of the original 286 core chemicals shows a decline of over 60 percent in total on-site and off-site disposal or release since the first TRI report of 1988. The pattern continues today. For example, the release of carcinogens to the air declined by 50 percent between 2003 and 2011.

5. Our book *Coming Clean* reports on a study designed to ask how information disclosure programs of this kind work and how they are able to bring about such impressive changes. This paper presents selected findings from the book and the implications of using an information disclosure policy strategy for the hydraulic fracturing industry.

6. The study reports on both reductions in release of toxic chemicals and effects on public health risks for the period 1991 to 2000, and it finds that despite an overall improvement in environmental performance that is highlighted in the annual TRI reports, the number of facilities nationwide that decreased their chemical releases (54 percent) was only slightly higher than the number that increased releases (46 percent). That is, there is wide variation among industrial facilities, states, and communities.

7. One of the fundamental ideas behind information disclosure is that knowledge of this kind about toxic chemical use and releases will inform the public, and in turn the public will press local industry to improve its environmental or other kinds of performance. Yet we found that facility managers do not hear very much from the public and do not interact with the public very often. Nor do local media cover facility operations and their chemical releases very often. Managers are far more likely to interact with facility employees, corporate management, suppliers, customers/end users, and regulators than they are with the public or community organizations.

8. Contrary to popular belief, we also found that facility managers are more positive than negative about the TRI program, and do not find the burdens or costs of compliance to be excessive. Managers reported that their experience with the TRI program increased their understanding of reporting needs, increased their ability to collect more accurate data each year, and helped to identify facility goals for reduction in chemical releases, among other impacts.

9. The TRI data are widely used by federal and state, although not local, officials, and among the most common uses were to assist with regulations and enforcement, to educate citizens about local pollution problems, to compare emissions to similar facilities, to compare facility emissions over time and check emissions against permit records, to increase knowledge of local pollution problems, to identify needs and opportunities for source reduction, to compare and evaluate public and environmental risks, and to set local, state, and regional priorities.

10. The major effects of federal and state officials using TRI data in these ways included undertaking pollution prevention activities, prompting source reduction efforts at local facilities, increasing media coverage, improving emergency management, and prompting meetings between industry and citizens.

11. Analysis of the TRI program suggests many ways in which information disclosure can be used in the hydraulic fracturing industry. Yet effective use requires careful program design so that communities are provided with timely, clear, accessible, and meaningful information that is used in conjunction with applicable regulatory laws.

Background: The Benefits, Costs, and Risks of Shale Gas Development

The development of shale gas over the past few years has dramatically altered the nation's energy economy in ways that are both very positive and troubling. The rapid diffusion of technologies, particularly hydraulic fracturing and horizontal drilling, have led to tens of thousands of new oil and natural gas wells across the United States that have yielded an abundance of low-cost natural gas while also boosting employment and state economies.

The price of natural gas and its long-term availability are good news to consumers and in many ways to environmentalists as well. Natural gas is lowering the cost of producing electricity and it is accelerating the transition away from comparatively dirty coal-fired power plants, which contribute significantly to air and water pollution as well as to greenhouse gas emissions linked to climate change. Coal combustion accounts for over 28 percent of U.S. greenhouse gas emissions, and over 90 percent of coal consumption takes place in the electric power sector. Shale gas emits about half of the carbon dioxide per unit of energy produced as coal.[3]

Yet low-cost and abundant natural gas supplies also are cited among the major reasons for the closure of non-fossil fuel energy plants and they are beginning to create barriers to development of renewable energy sources, such as solar and wind power. Among the plant closures are several nuclear power reactors that were shut down during 2013 because they were no longer competitive with natural gas, even though they could have continued for years under their present licenses to operate.

For all of its advantages, natural gas is, of course, a fossil fuel, and over time the nation and world need to reduce their reliance on fossil fuels to lower the risks of climate change. Some environmental scientists also worry about the leakage of methane from fracturing well casings and pipelines that could largely negate the advantages that use of relatively clean natural gas presents in comparison to reliance on coal for electricity production. Methane is a powerful greenhouse gas that presents a much greater risk for climate change than carbon dioxide, on which most climate change policy proposals focus.[4]

Challenges to State Governments from Hydraulic Fracturing

For these and other reasons, hydraulic fracturing presents the nation, and especially state governments, with some unique challenges. Public opposition to fracturing has risen, especially over concerns of possible contamination of groundwater and surface water with chemicals used in drilling operations.[5] Fracturing relies on the use of water injected under high pressure along with a mix of proprietary chemicals and sand to break up the shale deposits and release the natural gas. Drilling companies have been reluctant to release detailed information about the chemicals they use.

While some analysts think the possibility of chemical contamination is exaggerated, surveys indicate a high level of public concern about it, and many of the nation's leading environmental organizations now call for a wholesale ban on fracturing or fracking. France and Bulgaria, two countries that hold the largest shale gas reserves in Europe, chose to ban fracking even while they continue to rely on coal. There have been some highly visible public protests over fracking in England and Poland, and Hollywood films, most notably "Promised Land," have portrayed the fracking industry in highly unfavorable terms.

Short of a ban on the practice, which is unlikely in light of the considerable economic benefits of fracturing and the political clout of the oil and gas industry, states have other ways to respond to public fears. They can take steps to provide the public with information about the chemicals being used and their risks to public health and the environment. Many state surveys indicate strong public support for disclosure of the chemicals used in fracturing.[6] Armed with such information, people are thought to be empowered to pursue a variety of remedies.

State governments also may choose to regulate the process of drilling and extraction to ensure that companies operate safely and present no significant risks to public health and the environment, for example, from leakage of methane from unsound well casings and pipelines; unacceptable impacts on the land from construction, storage, and trucking; and public exposure to the noise and dust that is inevitable in this kind of industrial operation. Under current federal law, national action on hydraulic fracturing is greatly constrained, so in the near term, it is largely up to each state to act on its own.

The Use and Acceptance of Information Disclosure Policies

Mandatory information disclosure is used widely in the United States today, and it has been for years. Most people now take it for granted that they will be provided with information about ingredients in the food they buy, the safety of pharmaceuticals they use, the quality of their drinking water, the performance of public schools, and much more. When election season rolls around, we are reminded that federal campaign finance regulation depends heavily on disclosure of the sources of a candidate's campaign donations in a publicly available database at the Federal Election Commission.

As noted, many of these practices have been adopted over time for the same reasons. People believe they have a right to know about product safety or efficacy, for example, or the performance of public institutions. They also have come to expect that such information will be readily available online if not attached to a product itself, such as the fuel economy estimates and crash safety scores that are pasted on a window of every new vehicle sold in America today.

In the case of toxic chemicals, the U.S. Congress approved the Superfund Amendments and Reauthorization Act (SARA) in 1986, and included a new Title III, the Emergency Planning and Community Right to Know Act (EPCRA), which created the Toxics Release Inventory. Congressional enactment of EPCRA was stimulated by a massive chemical leak at an American owned pesticide manufacturing plant in Bhopal, India in December 1984. The Bhopal chemical leak is widely described as the worst industrial accident in history, with over 500,000 people affected to some degree.[7] Congressional action on EPCRA was closely tied to fears that an accident of that kind in the United States might release toxic chemicals that could seriously harm a local population.[8]

Even before the federal law gained approval, however, similar right-to-know laws began appearing at the state and local level for many of the same reasons. These included gains in scientific knowledge about chemicals and associated health and environmental risks, an increasingly educated and affluent public that viewed control of such risks as a priority; and the surging memberships and resources of environmental and consumer organizations that could bring political pressure to bear on policymakers to act on such risks. Above all, the prevailing culture at the time included a belief that businesses, and particularly manufacturing facilities, should be held responsible for any harm they might inflict on the public, and especially where the risks to public health are unknown to those who are exposed and not readily observable by them.

As a result of these factors, the push for right-to-know laws began in the 1970s, and by 1980, Connecticut, New York, Michigan, Maine, and California had enacted laws giving workers, and sometimes communities, access to information about chemicals used at local manufacturing facilities. During the 1980s, similar laws were approved at the municipal level. By one count, by 1984, seventeen states and sixteen municipalities had such laws on the books, and by mid-1985, twenty-eight states had them.[9]

In many respects, congressional action in 1986 followed these kinds of state and local initiatives across the nation and used them as a way to design federal law. Indeed, industry groups supported federal action in part because they hoped to preempt the growing number of conflicting state and local laws with a consistent national policy. Even after adoption of EPCRA in 1986, however, states continued to approve right-to-know legislation, most notably California, where voters approved a ballot measure, Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986. The law requires that citizens be informed when there is a reasonable risk of exposure to chemicals classified by the state as toxic. Voters approved the measure by a margin of 63 to 37 percent, despite intense opposition mounted by the initiative's opponents and a spending ratio by opponents over proponents of six to one.

A common set of assumptions underlies these kinds of public policy action that is pertinent to the case of shale fracturing. Perhaps most important is the belief that people have a right to know about industrial practices that may pose a risk to their health or the environment. Closely associated with recognition of such a right is the assumption that provision of information empowers individuals and consumers to take action, and indeed helps to mobilize community residents by raising the saliency of the issue and illuminating what they may see as a shared threat to their well-being.

Armed with pertinent information, individuals or community organizations, perhaps aided by coverage in the local press, might approach an industrial facility to clarify any risks that its operation might pose for the community's residents, and to ask or demand that the facility mitigate those risks. Similarly, citizens might approach state and local officials to seek additional information or to ask about existing or anticipated regulation of the facilities.

The presumption that underlies all information disclosure strategies of this kind is that the facilities and corporate managers will be responsive to such citizen inquiries (or to questions from state regulators) because they fear the consequences, such as harm to the reputation of a company, citizen protests, lawsuits, or regulatory actions they would prefer to avoid. While technically non-regulatory in nature, information disclosure policies of this kind have been described as "regulation by embarrassment."[10]

In the study described below, we found empirical evidence in support of such corporate concerns about reputation or image. When respondents, all facility managers who worked with TRI reports, were asked to rank the importance of various factors in how the facility managed its toxic chemicals, the facility's reputation ranked fifth out of thirteen factors. That put it behind concern over legal liability, environmental performance, regulatory compliance, and economic savings, but well ahead of expanding business, employee motivation, technology, regulatory anticipation, and even community relations. The last, of course, may be closely related to reputation.

The Federal Toxics Release Inventory Program and Its Achievements

The Toxics Release Inventory is the premier federal example of a non-regulatory environmental policy. It was designed expressly as an information disclosure policy in contrast to the prevailing reliance on command-and-control policies. Fairly or not, such regulatory policies often are criticized as excessively bureaucratic and prescriptive, inefficient in the way mandates are imposed on business for meeting regulatory standards, and for fostering an adversarial relationship between industry and government that can hinder progress in environmental performance. There is little question that reliance on regulation has created what Daniel Fiorino calls "an elaborate system of reporting, inspections, and penalties [that exist] to make people follow the rules."[11]

Although scholarly assessments of environmental regulation are mixed in their conclusions about the effects of conventional regulation, most students of environmental policy today believe that alternatives to regulation, such as use of market incentives, public education, and information disclosure, have an important role to play. These approaches are unlikely to replace regulation, but they can complement it, and possibly reduce the costs and other burdens imposed on business while also ensuring a safe environment and protection of the public's health. For states as well as the federal government, one of the most important tasks in the future will be designing and facilitating the development of the right mix of regulation and other policy strategies to achieve desired environmental and public health goals.[12]

As discussed earlier, states have a variety of choices over how to deal with the rapidly growing hydraulic fracturing industry. They can do little and rely on what some call "voluntary regulation," in which the industry essentially regulates itself with little or no oversight by state governments. They can extend existing environmental regulations to the industry where it is either exempt or where its activities do not fall under current regulations. They could mandate that companies engaged in drilling release certain information to the public, as many states already do.[13] Or they can opt for some combination of regulation and information disclosure in what scholars call hybrid policies.

The use of information disclosure is rapidly emerging as the preferred strategy for the industry, and this is precisely why it is helpful to look to the example of the federal TRI program to see how such a policy strategy has worked to date, what changes might improve its effectiveness, and the implications for the hydraulic fracturing industry.

The TRI program generally receives positive assessments from both policy analysts and government agency personnel. For example, the U.S. Environmental Protection Agency (EPA), which administers the program, has praised its achievements. From the first TRI report in 1988 to the present, the EPA annual reports note that we have seen the total on-site and off-site disposal or release of the 286 original or "core" chemicals on the list drop by over 60 percent. This overall improvement in environmental performance by industry is all the more impressive when taking into account that the U.S. economy in the same period grew by over 95 percent in real terms.

Moreover, chemical releases have continued to decline in recent years, and air releases in particular have declined appreciably. In its January 2013 TRI report (covering the year 2011), for example, the EPA notes that the release of carcinogens into the air declined by 50 percent between 2003 and 2011. At the same time, the nation has seen a decline in the public health risk of the chemicals as measured by the agency's Risk Screening Environmental Indicators (RSEI) model.[14] That model takes into account the toxicity of the chemicals being released from each facility, the height of smokestacks, prevailing winds, population density surrounding the facility, and other variables, and it yields an estimate of public health risks to the nearby community.

It should be said that for years many critics have questioned the reliability of TRI data, which is self-reported by industry and based upon estimates of releases and not actual measurements of them.[15] The concerns such critics raise, however, matter less when examining overall changes in releases over a long span of time. It also should be noted, however, that the modern TRI list covers over 650 toxic chemicals, and trends of declining releases of the original 286 chemicals may or may not apply to the newer ones added to the list since the late 1980s. There may well be a different pattern when newer chemicals are taken into account. Even so, the EPA clearly believes that use of an information disclosure policy strategy has proven its worth.

Our book *Coming Clean* highlighted the diversity of responses by industry that produces this impressive average decline in toxic chemical releases, and it underscores one important but often neglected characteristic of this record. It is that we have both leaders and laggards in terms of environmental performance. That is, while many industrial facilities significantly reduced their release of toxic chemicals and also lowered the health risks associated with their operation, some facilities moved in the opposite direction. They increased their release of toxic chemicals and/or increased the level of risk to surrounding communities attributable to their use of chemicals.

To be more specific about this variance, we classified companies into four categories: those that decreased both releases and risks (the "greens"), those that increased releases but lowered the risk ("blues"), those that decreased releases but increased the risk ("yellows"), and finally those that increased both the releases and the risks ("browns"). By our measures, the green facilities constituted 42 percent

of those reporting to the TRI from 1991 to 2000, the blues about 8 percent, the yellows 12 percent, and the browns 38 percent. That is, there were nearly as many brown facilities as green facilities for the time period we examined. To use a slightly different measure, the number of facilities nationwide that decreased their chemical releases (54 percent) was only slightly higher than the number that increased releases (46 percent). The data are presented in *Table 1*.

Table 1
Facility Environmental Performance: Air Releases and Risk, 1991 to 2000

Public Health Risk	TRI Air Releases	TRI Air Releases	Column Total
	Increasing (Dirtier)	Decreasing (Cleaner)	
Decreasing (Safer)	Blue Facilities 972 (8.0%)	Green Facilities 5,096 (42.1%)	**Safer 6,068 (50.1%)**
Increasing (Riskier)	Brown Facilities 4,604 (38.0%)	Yellow Facilities 1,447 (11.9%)	**Riskier 6,051 (49.9%)**
Total	**Dirtier 5,576 (46.0%)**	**Cleaner 6,543 (54.0%)**	**Total 12,119 (100%)**

Despite this variance across the nation's industrial facilities, it is clear that an information disclosure program of this kind can materially affect facility management and improve the environment surrounding these facilities. It is equally worth observing that the nation's facilities vary substantially in their environmental performance, and that progress by some does not translate into an across-the-board improvement. Given the variance in the size of facilities, it is also quite possible that a rather small number of facilities account for much of what shows up as national progress on release of toxic chemicals. One lesson is that all facilities must be monitored for their environmental performance over time, presumably by state and federal regulators, and lagging facilities in particular be encouraged and assisted in making greater progress.

What are the implications of such findings for natural gas fracturing? Much the same pattern of variance is likely to be found. That is, the tens of thousands of drilling operations across the nation are likely to be different in many ways, including their environmental performance. Some will be relatively small in scale and some large. Some will take exceptional care to protect land and water resources and others may do considerably less. Some will be in states with a record of strong oversight and regulation, and others will be in states that impose fewer expectations or conditions on drilling and public accountability. As a result of such variance, each state will need to assess its own conditions and develop appropriate public policies, including information disclosure policies that fit within the state's general posture on oil and gas drilling.

Key Findings from *Coming Clean*

In the book *Coming Clean* we sought to answer the question of how information disclosure actually works, and what effects it has on facilities and communities, using the TRI program as a case study. We view information disclosure as a policy strategy that mandates the release to the public of certain information provided by industrial facilities. Under EPCRA, all facilities that meet the threshold levels under the law must report annually. These thresholds pertain to the size of the facility and the quantity of listed toxic chemicals that the facility releases each year or that it sends to other facilities for waste management. EPCRA does not require reporting on all toxic chemicals released by every facility in the nation. Rather it is intended to capture most of the industrial facilities that release

substantial quantities of the listed chemicals. Many facilities fall below the minimal thresholds for reporting. Any similar program developed for natural gas fracturing operations may well use similar thresholds to limit the impact on smaller drilling sites.

In this study we emphasized the causal mechanisms in information disclosure and its effects because no other research had done so, and such knowledge is critical. It is not clear how such policies actually work and what impacts they have. That is, how does the release of technical information affect citizen behavior or the behavior of managers at the facilities? The design and implementation of disclosure policies depend upon knowing something about these mechanisms.

As noted earlier, for example, we know there are both leaders and laggards in facility environmental performance over time. So it is important to know what facility managers think about the TRI program, what they do with the information they collect, what their relationships are with state and federal regulatory officials, what interactions they have with citizens and the local media, and so forth. Similarly, it is important to understand the attitudes and actions of federal, state, and local officials who are involved with the TRI program. In particular, what do they do with the TRI data, and how useful do they think it is? Ideally, we would ask the same questions of citizens and community organizations if they can be studied, which is not easy to do. How well do they understand the information that is disclosed, and would the information be more useful to them if it were released in a different form? For example, would they find the information more intelligible and helpful if it were available as a measure of risk to human health rather than in pounds of chemicals released per year?

Methodology and General Findings

To address such questions, the study drew from the full TRI database for all facilities reporting in a ten-year period: 1991 to 2000. We started with 1991 rather than use the first years of the program (1988 to 1990) to eliminate bias related to program start-up difficulties. We collected TRI data for all facilities in the nation that reported in 1991, 1995, and 2000. Doing so eliminated those facilities that reported only in one or two of these years. That is, our main study group consisted of those facilities that continued some basic level of production over this ten-year period that was sufficiently high that they had to report data in all three years on their toxic chemical releases.

For each of these facilities, our database contains the reported releases as well as a measure of public health risk for chemicals released to the air. That information we drew from the EPA's RSEI model described earlier in the paper. The reason for doing this is that chemicals included in the TRI vary widely in their toxic effects. Indeed, they can differ by up to seven or eight orders of magnitude. That is, a single pound of one of the most toxic chemicals can be as risky as one hundred million pounds of the least toxic chemical.

In the end, our core database included the performance (releases and risk) of 8,389 facilities that reported via the TRI in 1991, 1995, and 2000. Among these facilities, the amount of toxic air releases was reduced significantly over time, about 44 percent on average, but as noted earlier, with substantial variation from the "green" to the "brown" facilities. There is also variation from one state to another, and from one industrial sector to another, and there are both big and bit players among the facilities.

Interestingly, a small number of large facilities account for a substantial percentage of the national releases, and they can distort the averages and conclusions reached about the impact of the TRI program on the nation's industrial facilities. For example, in 1991, about 33 percent of all reported TRI releases came from just 100 facilities. In contrast, the bottom 7,820 facilities combined contributed a similar one-third of total national releases. The top 100 facilities were mostly decreasing their releases over the 1991-2000 period as well (about 96 percent of them), whereas the bottom 7,820 facilities presented a more mixed picture, with 60 percent decreasing their releases and 40 percent increasing their releases.

Survey of Facility Managers

To answer our questions about facility perspectives and attitudes toward the TRI program, we administered a national survey to a sample of the 8,389 facilities in our database. In 2005, we sent questionnaires to 1,083 industrial facilities, and we also surveyed all state officials who oversee the TRI program in their states, and the top federal officials overseeing the program in each of the ten regional EPA offices. Return rates were acceptable to high: 24 percent for corporate respondents, 58 percent for state officials, and 80 percent for EPA officials. Return rates for surveys of corporate officials are almost always low, and our return rate compares favorably to the norm in such studies. We also used illustrative case studies that involved personal interviews with facility officials. This paper highlights only some of the findings, those that might be instructive for the natural gas fracturing industry.

Environmental Expertise at the Facilities

One pertinent finding is that the level of environmental expertise varies considerably from one industrial facility to another. For example, some 82 percent in our sample reported that the facility was ISO 9001 certified (general quality management), but only 35 percent were ISO 14001 certified (for having environmental management systems). Most of those that did not have ISO certification indicated they were not seeking it, in part because of the high cost for smaller facilities. Some 59 percent of the sample, however, did have some form of environmental management system even if not ISO certified. About half of the TRI contact officials in our sample indicated they were members of professional associations. But that means that about half were not, which might make a difference in the extent to which they keep informed about pertinent issues.

How might these findings relate to the fracturing industry? There are likely to be similar variations between larger and smaller companies. Smaller drilling operations may lack some of the experience and expertise of larger ones, and they also may have fewer resources to devote to the compilation and release of information about chemicals used in the process.

Does Information Disclosure Inform the Public and Promote Interaction with the Facility?

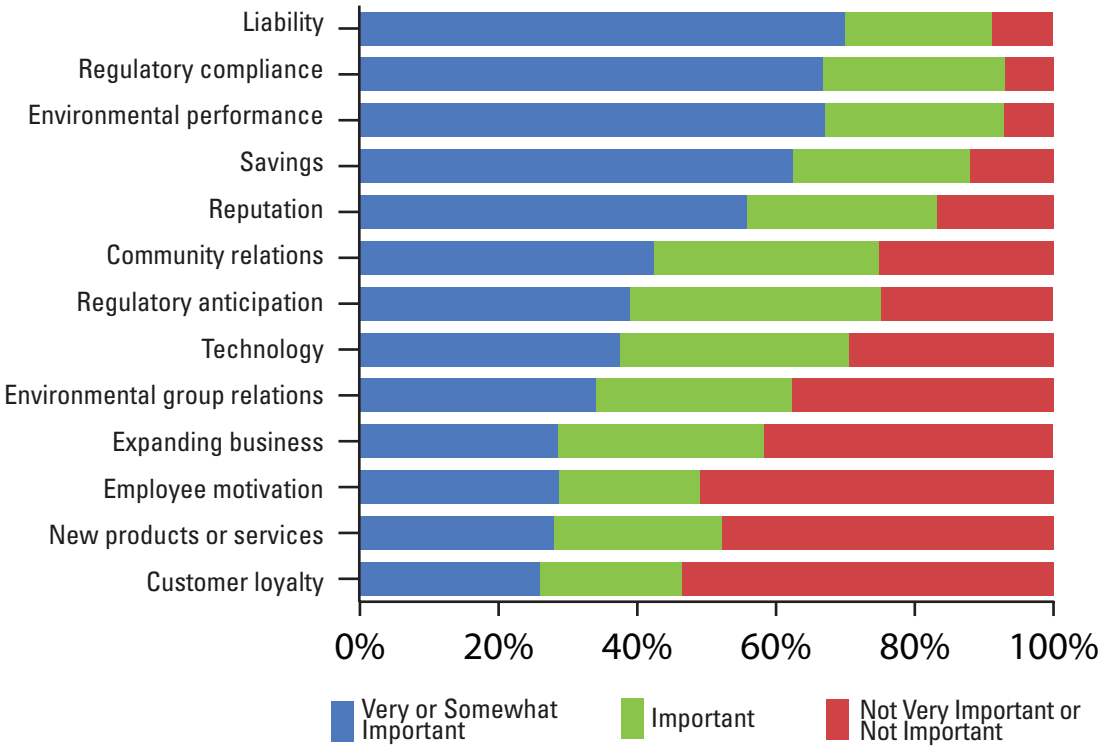
Some of the most interesting findings of this study concern the interaction between facility managers and others. One of the fundamental ideas behind information disclosure is that knowledge of this kind will inform the public, and in turn the public will press local industry to improve its environmental or other kinds of performance. Many studies suggest, however, that the public often is not aware of the information that is released, and thus is not empowered to act in the way that one might suppose.[16] Although we could not directly measure public familiarity with TRI data, we did find that facility managers did not hear much from the public and did not interact with the public very often. With whom do facility managers interact? Among those with whom they interacted most frequently were facility employees, corporate management, suppliers, customers/end users, and regulators. And among those with whom they communicated the least were trade associations, environmental organizations, community groups, local emergency planning committees, legislators, and the media.

In many ways these results are not surprising. Most of the time, the facility managers work with the facility's own employees, corporate managers, suppliers, and customers, but only rarely with the public. Relatively few facilities regularly (e.g., monthly or so) interact with the public or community groups, but many more will report at least an annual interaction of some kind. However, fully half of the respondents indicated that the facilities "rarely or never" interact with community members, and most indicated that they have even less interaction with the media. Given the origins of the TRI program and the assumption of community and media interest in the information being disclosed, these findings come as a surprise. They also suggest skepticism about the efficacy of merely disclosing information, and especially if the information is disclosed in a way that does not promote public and community understanding of public health risks.[17]

Issue Salience, Community Concern, and Industry's Management of Toxic Chemicals

One of our questions concerned the relative importance of a variety of factors in the facility's management of toxic chemicals. Here too we found that community relations were well down on the list of the most important factors. At the top were a desire to limit legal liability, followed by an interest in improving environmental performance and regulatory compliance. Economic savings was the next factor, closely followed by an interest in keeping or improving a facility's reputation. Only after these factors do we see a "desire to improve community relations." The results can be seen in *Figure 1.*

Figure 1
Pollutant Release Management Factors



What do these findings mean? Consistent with the relatively rare occurrence of media coverage of a facility or any regular communication with community or environmental groups, these findings tell us that dealing with community concerns normally is not a high priority for most industrial facilities. That is entirely understandable if no real issues have emerged or there is no media coverage of the facility. Yet once again it calls into question the assumption that the mere release of information to the public will stimulate community residents who live near an industrial facility to take an interest in its operation and seek to communicate with its managers. Certainly, there are well-documented cases in which one finds such a scenario. The EPA released a study in 2003 that is filled with such case studies.[18] Yet our survey results suggest that this is not the usual state of affairs.

Would we likely see a similar result in the case of natural gas fracturing? Much depends on how salient the issues are in the surrounding communities, the extent of media coverage, and whether what are called "intermediary" groups are present to acquire the information that is disclosed and to put it into language that ordinary people can understand and use. Such intermediary groups may be environmental organizations, public health groups, or other kinds of citizen organizations. They may be local groups, or regional or national groups that come into an area because of broad concerns over chemical releases.

We argued in *Coming Clean* that it is unlikely under most circumstances that citizens will seek out and use TRI data on their own. This is because ordinarily they have little reason to do so, and even if they tried, most people would find the information highly technical and difficult to understand without some assistance. In some communities, however, as the EPA study reported just above found, some citizens do take an interest, and they are able to mobilize others because of a perceived threat to public health. Or it may be that a citizens group is able to stir community interest in chemical releases. Certainly, a large accidental chemical release, such as the one in West Virginia that entered the Elk River in January 2014, attracts so much media attention that such mobilization is comparatively easy. The question remains whether citizens will organize around what might be called routine and small-scale use of chemicals or their release to the environment.

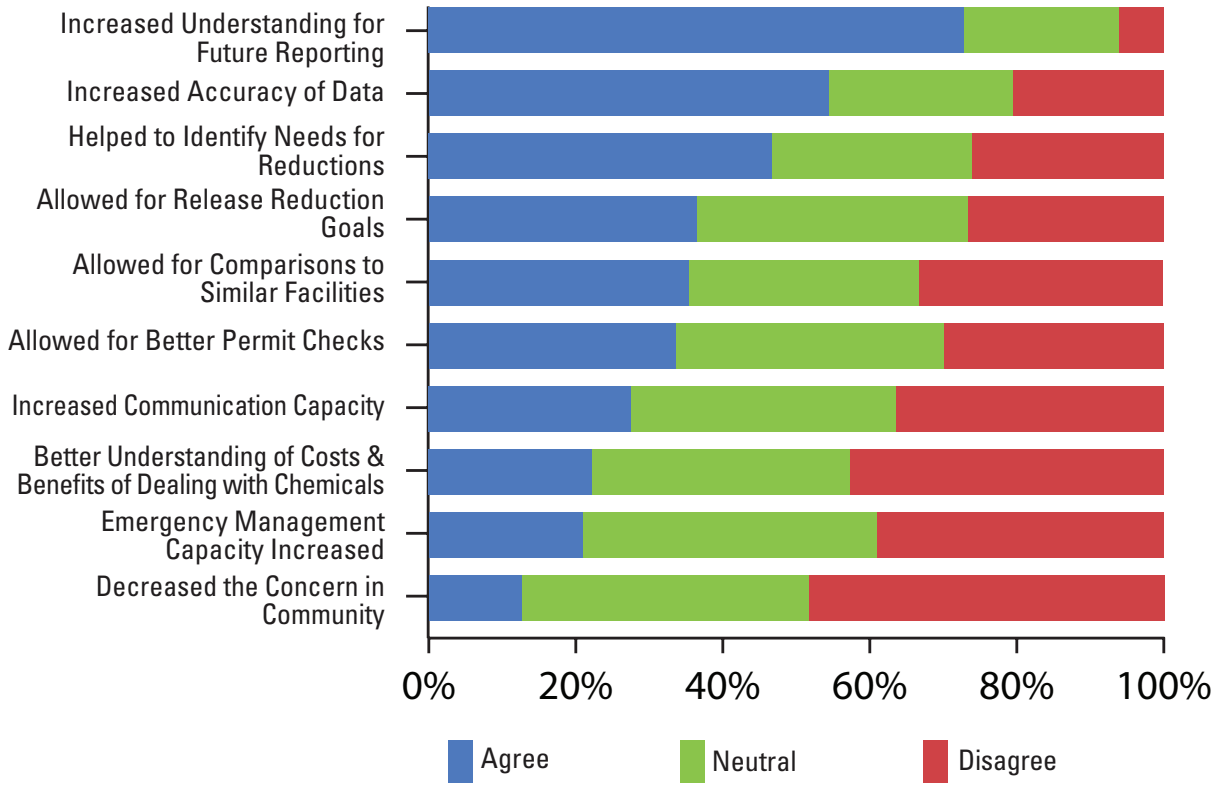
The Cumulative Effects of Working with Information Disclosure

One of the more interesting findings in the survey of facility managers is that they were far more supportive of, or at least tolerant of, the TRI program and its demands on their time than is portrayed in the media. For example, the George W. Bush administration in 2007 finalized a TRI Burden Reduction Rule that was designed to respond to industry complaints about the burden of compliance with program reporting rules; smaller facilities would provide information on a simpler form that provided fewer details about chemical releases. The American Chemistry Council, a leading trade association for the chemical industry, strongly supported action in an effort to reduce the costs and burdens of the TRI. But a dozen states sued the EPA over its new rule, and the Government Accountability Office (GAO) expressed concern that poor and minority concerns would be particularly affected by the reduced reporting of toxic chemical releases; that is, the GAO raised environmental justice issues. The EPA's own Science Advisory Board also objected to the rule. In early 2009, Congress adopted a budget bill with language that overturned the burden reduction rule, and the Obama administration's new EPA administrator, Lisa Jackson, applauded the move. She said the action would restore "the rigorous reporting standards of this vital program."[19]

Such efforts to reduce the burden that the TRI program imposes on industry implies that facility managers see the program in a negative light and would prefer to pull back from its requirements for collecting and disseminating information about toxic chemicals. Yet our survey of facility managers found no support for such an assumption. Indeed, nearly the opposite was the case. Managers reported that their experience with the TRI program increased their understanding of reporting needs, increased their ability to collect more accurate data each year, and helped to identify facility goals for reduction in chemical releases, although most reported that it did not appreciably affect their ability to discuss releases with the community, or improve their understanding of the costs and benefits of chemical management. Asked to rate their overall experience with the TRI, 37 percent were positive, 51 percent were neutral, and only 12 percent were negative. To put these findings slightly differently, fully 88 percent were not negative about the program.

Moreover, when asked about the effects of their experience with the TRI program, industry officials saw many specific benefits to praise. In descending order, they highlighted an improved understanding of the reporting system itself (so that future reporting would be easier and less time consuming), increased accuracy of the data they report because of familiarity with it, help in identifying needs for reduced use of chemicals as well as reduced releases of chemicals, improved capacity for checking on compliance with permits, improved ability to compare operations at similar facilities, increased communication capacity, an improved understanding of the costs and benefits of working with the chemicals, an increased capacity to respond to emergencies, and a decrease in community concerns about the facility. These effects help to explain why the overall assessment of the TRI program was far more positive than negative. The results are shown in *Figure 2*.

Figure 2
Effects of TRI Experience



What are the implications for the natural gas fracturing industry? The industry has been reluctant to accept information disclosure requirements despite strong public support for such a policy strategy. Industry managers might take heart in these findings. After years of experience with reporting requirements, facility managers in other industrial sectors have not reported exceptional burdens in compiling and releasing the information. Nor have they faced the kind of intense and negative community reaction that some corporate official might fear would occur in the fracturing industry. Moreover, the internal auditing and collection of information by facility managers turns out to be quite valuable to them in ways they did not anticipate. Many touted the benefits of information collection, particularly in alerting them to ways to improve production processes that saved them money, reduced their releases, and improved relations with local communities. Of course, as noted, a relatively small minority of respondents criticized the program, and they did not see such benefits or value them highly. As is the case with other findings in this study, much depends on the individual company or facility. Nonetheless, the broader picture of a neutral to positive view of the TRI program and its effects is contrary to the conventional wisdom of industry opposition to such programs.

How TRI Data Are Used by Federal and State Officials

By definition, information disclosure programs are not regulatory in nature. However, once collected and made public, states may choose to incorporate the information into their regulatory programs in some ways. Our survey of federal, state, and local officials was quite revealing of how they use the TRI data. Much the same may be the case with information disclosure in the natural gas fracturing industry.

Asked how they used TRI data, federal and state officials reported a range of uses, whereas local officials (members of the local emergency planning committee that operate under EPCRA) were quite different. Even though they are closer geographically to the facilities, local officials simply did not perceive the TRI chemical data as falling within their area of concern; most seemed to have very

little awareness of the data and paid little attention to the information. In sharp contrast, federal and state officials used the TRI data extensively. As shown in Table 2, among the most common uses were to assist with regulations and enforcement, to educate citizens about local pollution problems, to compare emissions to those of similar facilities, to compare facility emissions over time and check emissions against permit records, to increase knowledge of local pollution problems, to identify needs and opportunities for source reduction, to compare and evaluate public and environmental risks, and to set local, state, and regional priorities.

Table 2
Use of TRI Data by Federal and State Officials

How TRI Data Were Used	Federal Officials	State Officials
Compare emissions to similar facilities	87.5 %	29.4%
Assist with regulation and enforcement	75.0	35.3
Educate citizens about local pollution problems	62.5	38.2
Compare facility emissions over time	62.5	32.4
Check facility emissions against permit records	62.5	29.4
Compare and evaluate public environmental and health risks	62.5	20.6
Increase my knowledge of local pollution problems	50.0	32.4
Identify needs and opportunities for pollution prevention and source reduction	50.0	26.5
Prepare company profile(s)	50.0	14.7
Set local, state, and regional environmental priorities	37.5	23.5
Prepare for court litigation	25.0	5.9
Assist in citizen/industry negotiations	25.0	2.9
Contact local businesses about pollution problems	12.5	11.8
Assess the adequacy of current laws	12.5	5.9
Exert public pressure on area businesses	12.5	0.0
Identify needs for emergency management	0.0	14.7

We might anticipate a similar set of opportunities for state officials with access to data on natural gas fracturing. That is, armed with current and comprehensive data on chemicals used in the drilling process, the officials might well use the information to complement state regulatory enforcement, to educate citizens about local pollution problems, to compare practices and chemical uses at similar

facilities, to compare chemical uses over time, to educate local citizens on any issues that might arise, and to offer some assurances to citizens who are concerned about, say, water contamination or other environmental impacts of drilling. Making such information publicly available might not lead to increased regulation or to increased citizen opposition to drilling. If the environmental and health risks are indeed minimal, then making the information public may offer citizens some degree of assurance of safety that in many cases they do not now have. Where there are genuine reasons for concern about chemical contamination, the impact may be different, of course. But at least the company then has the opportunity to work with local residents in making appropriate changes in its operations.

The example of the TRI program also speaks to how hybrid policy approaches work. Information disclosure is not at odds with regulation. The information it provides is seen as very helpful to state and federal regulators. It allows them to engage in their regulatory tasks more effectively. Hence information disclosure complements rather than competes with regulation. In states where a good relationship exists between industry facilities and regulators (more common than often assumed), the two kinds of policy strategies can work side by side and not lead to increases in regulation or a greater burden on industry.

The Effects of Using TRI Data: What Public Officials Reported

These conclusions are reinforced by another of our findings. These concern the effects of using TRI data as reported by federal, state, and local officials. As shown in Table 3, the leading effects include undertaking pollution prevention activities, prompting source reduction efforts at local facilities, increasing media coverage, improving emergency management, and prompting meetings between industry and citizens. Additional regulation or legislation, or new litigation, was very rarely a result of using the TRI data.

Table 3
Effects on Public Officials of Using TRI Data

Effects of Using TRI Data	Federal Officials	State Officials	Local Officials
Pollution prevention (P2) activities were undertaken	87.5%	47.1%	3.5%
Source reduction efforts were effected at local plants	50.0	52.9	3.5
Media coverage increased	50.0	35.3	0
Industry-citizen meetings were prompted	37.5	20.6	1.7
Litigation took place or the data were used in litigation	25.0	8.8	1.7
Emergency management was improved	12.5	26.5	10.3
Legislative, regulatory, or administrative changes occurred	12.5	14.7	1.7
No activities resulted	0.0	8.8	6.9

What are the implications for use of information disclosure in the fracturing industry? They might be very similar. The collected data could be very useful to state and local officials. They could work with industry in a variety of ways that might reduce any risk of chemical contamination, and they could assist in developing appropriate pollution reduction activities. They also could help to prepare local communities for any accidental chemical spills or incidents, and to arrange meetings between industry and citizens that could resolve disputes or reduce community concerns about chemical risks.

Conclusions and Implications for Natural Gas Fracturing Operations

The evidence reviewed in this paper points to several important conclusions about the Toxics Release Inventory program and the implications for natural gas fracturing. Perhaps the most important conclusion is that the TRI program has produced impressive results since the first national inventory report of 1988. The decline in release of toxic chemicals to the environment provides at least some reason to believe that information disclosure programs can have material effects on industry facility operations, and both reduce the overall level of chemical releases and reduce the risk to public and environmental health.

Another important finding is that the general pattern of reduced emissions and reduced risk levels do not apply to industrial facilities across the board. That is, there is significant variation among facilities in their capacity or willingness to make operational changes that will result in reduced emissions and risk. In addition to the substantial variation across the thousands of industrial facilities in the nation, we also found variation across the states. We believe these variations reflect differences among the states in administrative capacity, commitment to environmental protection as a goal, and state political cultures, among other factors. These same variables are likely to affect the kinds of information disclosure or regulatory policies that the states adopt and perhaps the commitment to full implementation of those policies.

The Challenge of Selecting the Right Metric

One of the longstanding weaknesses of the TRI lies in the metric used. Facilities report the pounds of chemicals released to the environment each year. Not only is the information highly technical and not easily understood by community residents, an even greater weakness is that the information is not directly related to public health risks. The public might be alarmed about the quantity of a given chemical that is released, but the reality is that it is almost impossible for citizens to determine a public health risk from such information. A thousand pounds, or hundreds of thousands of pounds, of a given chemical might seem to be dangerous based only on the quantity, but a far smaller quantity of a different chemical might be more dangerous to the community. In addition, as noted earlier, the numbers themselves are estimates and not actual measurements of what is released by the facility.

What most people probably want to know about the release of toxic chemicals is whether they might adversely affect their health. The raw TRI data cannot help much in this regard, and the EPA developed the RSEI model in part to give citizens and state and local officials a more useful metric. Yet the EPA was reluctant to release RSEI data to the public. For years the data could only be found on a special database. Going forward, it would seem important to provide such public health risk information to the public and to do so in a manner that facilitates public access and understanding. For example, eventually we could have a database that contained such public health information by zip code or in a map format that provides quick identification of all industrial facilities within a given community and both the chemical release information and related health risks.

One of the challenges in moving in this direction is reaching agreement on how best to characterize the public health risks. As noted, the EPA has developed models for air releases, but in the case of the fracturing industry, releases to the land and to water sources are likely to be of much more interest. Some way might be found to report not only which chemicals are being used in drilling operations, but what risks they might pose to the community through various routes of exposure. Most of the time these risks might be minimal, but nonetheless, the community has a right to know about them. Even if only a few people or organizations seek such information, it should be available to them and in a format that improves understanding of health risks.

Similarly, rather than report annually, as is the case with the TRI, we might develop a better way to reflect increasing or decreasing environmental performance of a given facility. That is, citizens might want to know if a facility is improving over previous years and, if so, by how much. Such a simple metric of performance could be provided by the industry or calculated from a series of annual reports. Chemical use does vary from year to year, as does a facility's level of activity. Yet it should not be too difficult to devise a simple and yet meaningful measure of environmental performance. One such effort for the TRI program can be found at the Web site for the Toxic Trends Mapper: http://toxictrends.org, developed by the Huxley Spatial Institute at Western Washington University in conjunction with the Environmental Council of the States. One locates a facility via a map interface, and information on changing performance over time is available directly on the site. In this example, both raw release data and risk information are provided.

How to Improve Public Attention to Chemical Information and Its Use

A further problem with information disclosure programs of this kind is that most people are not motivated to seek out and use the information, and those with some modest level of initial interest may not maintain that interest over time. The same conclusion applies to local or state media coverage and to a lesser extent to community organizations. With the TRI program, we found very little evidence of persistent public interest in the information, and media coverage of TRI reports seemed to decline sharply over time.

To the extent that state policymakers might want to encourage public interest in the information and public involvement in any decision making processes related to chemical releases, they will have to use creative approaches to the design of Web sites to attract and maintain public interest. The provision of risk information is a challenge. There is always a chance that the public will be confused about the information that is provided or that people might be unnecessarily alarmed by it. States and localities might consider the use of focus groups or other ways to involve the public in the design of such information disclosure Web sites so that the best approach can be found.

One conclusion from our study of the TRI is that for information disclosure programs to be effective, they need to provide the information in a way that is current, simple, clear, and accessible. That is, to the extent possible, the information should reflect chemical releases in the last year or so, and not be years out of date. The information should be simple rather than complex, because most users of a database will not be technically trained to understand it if presented, for example, in chemical formulas or names that few will recognize. The information also needs to be clear and not require unusual interpretation by specialists or repeated Internet searches to discover what it means.

Finally, the information should be easily accessible. That is, one should not have to spend a great deal of time to locate the information. Local facilities near one's residence or zip code should be identifiable with a simple data entry on a Web site. One commonly used means of information disclosure in the fracturing industry, for example, FracFocus (http://fracfocus.org/), fails to meet these simple and reasonable standards. To use this system, one needs to identify specific wells in a given area, and the information provided is the name of chemical used and actual or maximum concentration considered to be hazardous. One has to wonder if this approach serves the interest of local citizens.

One way to overcome the inherent limitations that most citizens have in accessing and interpreting the information is to rely on intermediary organizations, such as community groups, public health organizations, or environmental groups. A local college or university might be persuaded to host the information and to interpret it. Or a Facebook page could be created that allows interested citizens to share interpretations or concerns they have about the information. Social networks have not been used much to date in connection with TRI information, but there is no reason they cannot be. Local media also could help, of course, as they now do with respect to a great deal of other news and information. Almost all have Web pages where they provide information or links for those interested in learning more about a given subject.

The Value of Hybrid Policies

This paper focuses on information disclosure as a policy strategy, but as noted earlier, one typically sees a combination of regulation and reliance on information disclosure. By itself, the disclosure of information imposes a small burden on industry and potentially can provide valuable data to the public. Yet our findings from *Coming Clean* clearly indicate that industrial facilities provide TRI information in the larger context of existing federal and state environmental laws and regulations. This is why facility managers indicate that among the most important factors in their management of toxic and hazardous chemicals are a concern over legal liability, environmental performance, and regulatory compliance. That is, their judgment about what needs to be done is affected by a combination of concerns that include the facility or company's reputation and community reaction, but also the anticipation that much of what occurs at a facility also falls under federal or state regulation.

Put otherwise, an information disclosure policy that is accompanied by no state or federal regulation is unlikely to be very successful on its own. The task for state, and even local, governments is to find the right combination of information disclosure and regulation that serves the public interest while not imposing too great a burden on industry. The combination may well vary from state to state and from one industrial sector to another. For the fracturing industry, a combination of state regulation and information disclosure is likely to work better over time than reliance on information disclosure alone.

Consideration of Leaders and Laggards

Beyond the policy choice that states and localities face is a related matter: how to improve the performance of facilities that fall short of expectations, and for that matter, how to recognize and reward those facilities that do exceptionally well. Leading facilities or drilling operations can be recognized for their efforts at environmental protection, rewarded in some fashion, and encouraged to continue doing well. Intermediary organizations can help in identifying such facilities and urging state and local governments to act. Those facilities that lag behind expectations can be offered various forms of assistance to help them to comply with existing regulations and expectations. They also may be sanctioned in some way as a deterrent in the way that most environmental laws do.

Oversight of Information Disclosure Programs

These considerations also suggest the need for some kind of oversight of any information disclosure program that is developed for the fracturing industry. That is, once established, such a program may or may not live up to the expectations of state government or citizens. Which governmental organization or external group should be charged with such oversight of implementation? The implementing agency itself? A non-governmental organization? A public health department? An environmental agency? To do nothing would weaken the program.

Oversight of implementation would likely include some determination of whether each facility is responding sufficiently to community concerns. It is possible that a facility or drilling operation discloses information but then is unresponsive to a community's concerns. What should the state or local government do in such instances? Creation of some kind of appeals process might make sense. Having one would help to inspire facilities to be responsive to public concerns and also would establish a way for citizens to act on their concerns if they believe that a facility is not being responsible.

What to Do About Proprietary Chemicals?

One of the concerns expressed by the fracturing industry is that any information disclosure should exempt what is called trade secrets, or proprietary chemicals, used in the drilling process. Yet doing so would deprive citizens of important information. So some way must be found to report information that is complete, meaningful, and useful to the public while not compromising the legitimate concerns of industry.

Federal-State Relationships

A number of existing federal laws preempt the federal government from regulating the natural gas fracturing industry, leaving the decision up to each state. In the last few years, many states have quickly adopted information disclosure policies for the industry, but some of them appear to be quite limited or weak. We may well see a kind of "race to the bottom" among states eager to attract a thriving industry but reluctant to regulate it or concerned about the burden imposed on the industry by tougher information disclosure policies. At present, the policy choices remain at the state level, and citizens might well consider whether a particular state policy is sufficient to protect their interests or not.

As discussed earlier, many recent surveys indicate a high level of public support for disclosure requirements in the fracturing industry. At the same time, there continues to be broad public support for fracturing itself. Development of an effective information disclosure policy for the industry need not unduly constrain its operation. But states and local governments will have to find a way to respond to a clear public preference for information about the chemicals used in fracturing and the risk those chemicals might pose to public health and the environment.

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Notes

1. Michael E. Kraft, Mark Stephan, and Troy D. Abel, *Coming Clean: Information Disclosure and Environmental Performance* (Cambridge, MA: MIT Press, 2011).
2. See, for example, Richard Liroff, Danielle Fugere, Lucia von Reusner, Steven Heim, and Leslie Samuelrich, "Disclosing the Facts: Transparency and Risk in Hydraulic Fracturing Operations" (Falls Church, VA: Investor Environmental Health Network, 2013), available at http://disclosingthefacts.org/.
3. These figures are taken from the Center for Climate and Energy Solutions and can be found at http://www.c2es.org/energy/source/coal.
4. There is considerable uncertainty about the extent of methane leakage because it has not been thoroughly studied to date. For commentary on the issue and the controversy surrounding it, see Mark Bittman, "Is Natural Gas 'Clean'? *New York Times*, September 24, 2013.
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6. Brown, et al. 2013.
7. See Charlene Crabb, "Revisiting the Bhopal Tragedy," *Science* 306 (December 3):1670-1671.
8. See Susan G. Hadden, *A Citizen's Right to Know: Risk Communication and Public Policy* (Boulder, CO: Westview Press, 1989), Chapter 2.
9. The history of the Toxics Release Inventory and these related efforts at the state and local level are taken from Kraft, Stephan, and Abel, Chapter 1, which in turn drew heavily from Susan Hadden's *A Citizen's Right to Know.*
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17. These findings are presented and discussed in Coming Clean, Chapter 5.
18. The EPA offers a series of case studies to illustrate how various communities have used the TRI data successfully to press industry to improve its performance. See U.S. Environmental Protection Agency, "How Are the Toxics Release Inventory Data Used? Government, Business, Academic and Citizen Uses" (Washington, D.C.: Office of Environmental Information, Office of Information Analysis and Access, May 2003), available at www.epa.gov/tri/guide_docs/pdf/2003/2003_datausepaper.pdf.
19. The proposal and various assessments of it are discussed in Kraft, Stephan, and Abel, Coming Clean, Chapter 7, 170-178.

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