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PATHWAYS TO DIALOGUE

*What the Experts Say about the
Environmental Risks of Shale Gas Development*

OVERVIEW *of* KEY FINDINGS



RESOURCES
FOR THE FUTURE

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Resources for the Future (RFF) is an independent, nonpartisan organization that conducts economic research and analysis to help leaders make better decisions and craft smarter policies about natural resources and the environment. Located in Washington, DC, RFF's research scope comprises programs in nations around the world.

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EXPLOITING THE NATURAL GAS CONTAINED IN SHALE formations has lowered the cost of electricity, industrial feedstock, and residential and commercial energy and has even spurred the use of natural gas as a transportation fuel. Nevertheless, shale gas development is extremely controversial, in part because the potential health and environmental risks related to the drilling and production activities are not well understood. Experts at Resources for the Future (RFF) have been examining these risks from multiple perspectives to provide objective research to help leaders make informed decisions on these issues.

This report is the first survey-based, statistical analysis of experts from government agencies, industry, academia, and nongovernmental organizations (NGOs) to identify the priority environmental risks related to shale gas development—those for which the experts believe government regulation and/or voluntary industry practices are currently inadequate to protect the public or the environment.

The results stand in sharp contrast to the rhetoric of much of the public debate.

For example, a key finding is the high degree of consensus among experts about the specific risks to mitigate. These “consensus risks” are those that survey respondents from all four expert groups most frequently identified as priorities for further regulatory or voluntary action. Although this survey does not rank any of the potential risks by level of importance, the results do indicate that progress toward productive dialogues may be most likely achieved around these consensus risks.

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Several of the consensus risks pertain to impacts that have received relatively little attention in the popular debate. For example, the experts frequently identified the potential impacts on lakes, rivers, and streams (surface water) as a priority; less frequently, they identified potential risks to underground aquifers (groundwater).

In fact, only 2 of the consensus risks identified by the experts are unique to the shale gas development process, and both have potential impacts on surface water. The remaining 10 consensus risks relate to practices common to gas and oil development in general, such as the construction of roads, well pads, and pipelines and the potential for leaks in casing and cementing.

These findings provide industry leaders, policymakers, and the public with a firm starting place for further dialogue in balancing the benefits and risks of shale gas development.

ABOUT THE SURVEY

- ✓ 215 shale gas experts from NGOs, academia, industry, and government agencies responded to the survey questions.
- ✓ Survey respondents were asked to identify the routine risks related to shale gas development that they considered priorities for further mitigation (via government regulation and/or industry voluntary action). They were not asked to rank the risks, just to indicate if they believed that current practices are adequate to protect the public or the environment.
- ✓ Respondents were asked to choose from 264 possible risk pathways that link routine shale gas development activities—from site development to well abandonment—to the burdens (such as stormwater flows) that impact the environment and local communities in various ways (such as surface water quality).
- ✓ In addition to these routine risks, the survey also asked about priorities for reducing potential accidents and priorities for addressing specific types of environmental burdens related to fluids used in shale gas development.
- ✓ Finally, survey respondents were asked who should have primary authority to ensure that risks are mitigated—government (via regulation), industry (via voluntary action), or a combination of both.

ABOUT THE RISK MATRIX

This survey was based on the Risk Matrix for Shale Gas Development, which is a catalogue of all the plausible environmental risks associated with the development of shale gas. Developed at RFF with input from geologists, hydrologists, economists, risk assessors, and representatives from industry and environmental groups, the risk matrix includes 264 “risk pathways” that link activities associated with shale gas exploration and development to their possible impacts on the environment. View the Risk Matrix for Shale Gas Development at www.rff.org/shaleriskmatrix.

Priority Risks Related to Routine Operations: Areas of Consensus and Disagreement

RFF's research team analyzed the survey responses from each expert group (industry, NGO, academic, and government) and identified the risk pathways that were most frequently chosen and least frequently chosen as priorities by each group (out of the 264 possible risk pathways). The 20 risk pathways that were most frequently chosen by each expert group were compared.

Each oval in Figure 1 represents the 20 priority risk pathways¹ for each group and demonstrates the degree of overlap among the groups.

The 12 Consensus Risk Pathways Agreed upon by All Expert Groups

In Figure 1, the 12 consensus risk pathways that all of the expert groups most frequently chose as priorities are indicated in green. In fact, at least one-third of the experts in each group identified these 12 specific pathways as priorities from the 264 possible choices.

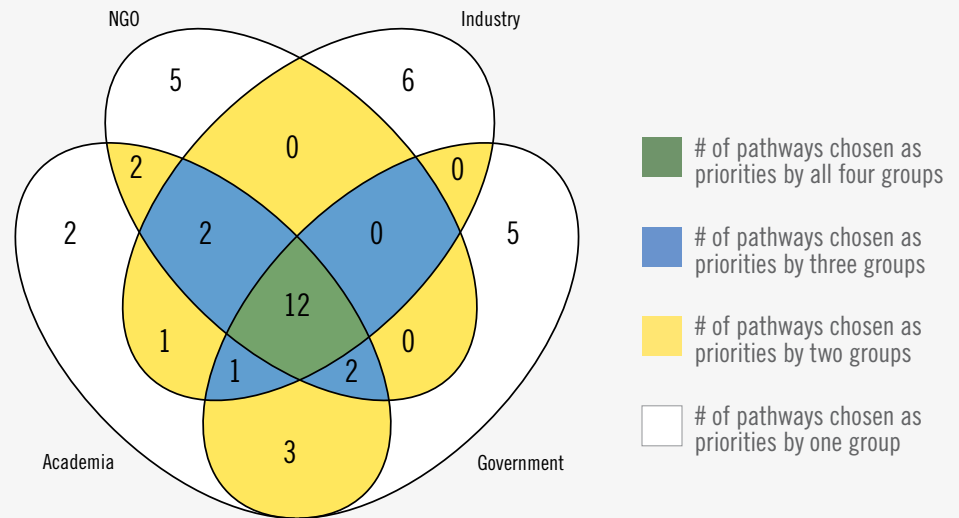
Of the 12 consensus risk pathways (see Figure 2):

- » 7 involve potential risks to surface water quality,
- » 2 involve potential risks to air quality,
- » 2 involve potential risks to groundwater quality, and
- » 1 is related to habitat disruption.

¹ Note that, as a result of ties in the numbers of experts selecting a priority, the “top 20” actually includes 23 priorities for NGO experts, 22 for industry experts, 25 for academic experts, and 23 for government experts.

FIGURE
1.

Degree of Agreement among Each Expert Groups' 20 Priority Risk Pathways



Despite significant public and regulatory concerns about groundwater risks, risks to surface water were a dominant concern among the experts. Similarly, both of the air quality risks involve methane (which has implications for climate change), rather than conventional local air pollutants (such as nitrogen dioxide). The threat of habitat fragmentation from shale gas development infrastructure is also a consensus risk pathway, despite (or perhaps because of) its relatively low profile in the public debate.

Although some of the impacts of the 12 consensus risk pathways described above have not received wide media attention, several activities associated with these impacts have, including:

- » on-site pit and pond storage of flowback liquids,
- » freshwater withdrawals for hydraulic fracturing,
- » venting of methane, and
- » treatment and release of flowback liquids.

Finally, none of the 27 possible risk pathways that result in potential impacts on soil quality were identified by the experts as priorities. Similarly, each expert group identified only 1 (and the same one) of the 31 pathways pertaining to habitat disruption.

FIGURE
2.

12 Consensus Routine Risk Pathways



Where the Experts Do Not Agree

Expert groups were divided in the priority assigned to risk pathways outside of the 12 consensus pathways.

A significant number of pathways were included in the top 20 of only one group (indicated in white in Figure 1). Industry respondents identified 6 priority risk pathways related to

community disruptions, such as road congestion from truck traffic associated with shale production. The 5 unique pathways selected by NGO respondents mostly target conventional air pollutants.

The 5 unique pathways selected by government respondents focus entirely on groundwater risks. Academic respondents identified only 2 unique risk pathways: one relating to the potential for newly industrialized land to disrupt nearby communities and the other relating to the impact on groundwater from using freshwater withdrawals for drilling.

Some risk pathways produced consensus among two or three groups (indicated in yellow and blue in Figure 1), but not across all four groups.

- » The potential impact on surface water from using wastewater for road deicing or dust suppression was a high priority for all expert groups except industry.
- » The impact on groundwater from hydraulic fracturing flowback was most frequently identified by NGO and academic respondents but less so by other experts.
- » Likewise, seismic vibrations caused by deep underground injection of flowback and produced water was a high priority for industry and academic respondents, but not for government and NGO respondents.

Five of the most disagreed upon pathways are related to community disruptions (including seismic vibrations). Industry respondents (and, to a lesser extent, academic experts) consistently noted that they were a high priority, more so than NGO respondents (and, to a lesser extent, government experts).

Finally, on average, NGO experts identified about twice as many routine impact pathways as high priorities for further action compared to the experts in the other three groups.

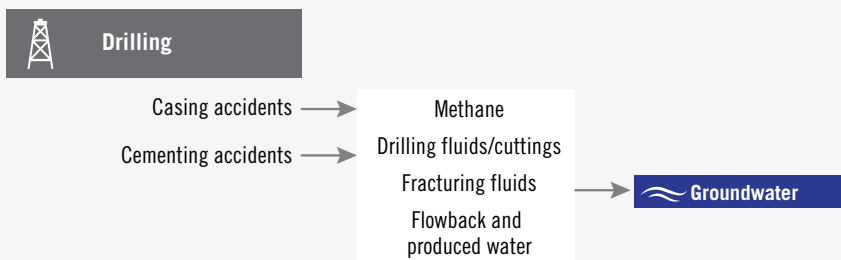
Risks of Accidents

In addition to potential risks associated with routine shale gas development, experts also reviewed a list of 14 potential accidents (such as those involving trucks servicing the development site or cement or casing failure). They were asked to identify high-priority accidents—those that they believed require further attention by government or industry—and to note the probability of the accident occurring and the likely severity of its impact.

All experts identified the same two accidents in their top three most frequently chosen priorities: cement failure and casing failure (see Figure 3). The NGO, academic, and government experts all identified leakage of wastewater pits and ponds (impoundment failure) as their other top priority, whereas the industry group identified truck accidents instead. Compared with the other experts, the NGO experts generally noted that the priority accidents were more likely to occur and that they would have more severe impacts.

FIGURE
3.

Accident Risk Pathways



High-Priority Environmental Burdens

Environmental burdens are the outcomes of shale gas activities; these burdens include air pollutants, intrusion of saline water into aquifers, noise pollution, and road congestion. Experts were given an opportunity to identify which burdens are priorities for further government or industry action. This part of the survey focused on the 104 specific fluid burdens created as part of the shale gas development process.

The fluid burden most frequently identified as a priority by all four groups is the naturally occurring radioactive materials found in flowback and produced water as well as in drilling fluids and cuttings. Of the 10 fluid burdens most frequently identified by each group, 6 are in common among all of the expert groups (see Table 1).

TABLE
1.

Six Fluid Burdens Identified by All Expert Groups as Having a “High Priority” for Further Action

WHERE THE FLUID IS FOUND	FLUID BURDEN
Flowback and produced water	Naturally occurring radioactive materials
	Aromatic hydrocarbon
	Hydrogen sulfide
Drilling fluids and cuttings	Diesel oil
	Naturally occurring radioactive materials
Fracturing fluids	Oils (including diesel)

Differences within the Expert Groups

The survey also examined how specific characteristics of the respondents influenced their survey responses. For example, experts differ in their subaffiliations (such as federal and state government officials within the “government” expert group) and in self-reported expertise levels, experience, and educational background. These differences generally had no effect on survey responses, except in the case of subaffiliation.

For example, federal government expert respondents appeared more concerned with air quality risks (notably flaring of methane), which were less frequently identified by state government experts as a whole. However, federal experts rarely identified risks stemming from the disposal of drilling fluids, drill solids, and cuttings as a priority, unlike state experts.

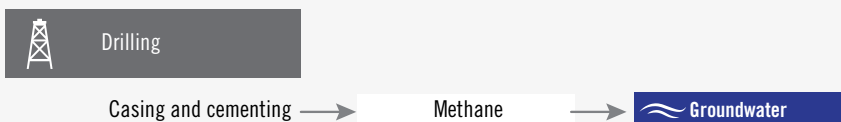
The industry experts were divided into two groups: those representing extraction and producing companies and those affiliated with any other part of the shale gas industry, including pipe manufacturers, pipeline companies, consulting firms, law firms, and industry advocacy groups, among others. Whereas industry experts overall chose community impacts more often (relative to other pathways) than did other groups, extraction industry experts chose community impact risk pathways even more often than the industry group as a whole. However, the potential impact on surface water from applying wastewater for road deicing is ranked very low by extraction experts, despite being within the top 20 priority risk pathways for all other groups (including nonextraction industry experts).

Self-identified “top experts” (those rating themselves as having high levels of expertise in given activities) gave priority to 10 of the 12 consensus pathways. The potential impact on surface water from storing fracturing fluids at a drill site—during the fracturing process and afterward, in pits and ponds—was not identified very often by fracturing and fluid storage top experts.

The possible routine escape of methane into groundwater as a result of casing and cementing problems was often identified as a priority by drilling top experts, including all of the NGO top experts (see Figure 4). The NGO group in general did not select this pathway in its top 20 priorities; however, this pathway was among the top 20 priorities for industry, academic, and government experts.

FIGURE
4.

Additional Routine Risk Pathways Identified By Top Experts



Preferences for Regulatory and/or Voluntary Action

When sharing of authority was an option, all groups agreed that **government and industry should share the authority for risk mitigation, to some degree.**

When asked to choose government or industry as the primary party with authority to address the risks that the experts selected as priorities, NGO, academic, and government experts selected government more often than industry, whereas industry experts selected government and industry equally. When sharing of authority was an option, all groups agreed that government and industry should share the authority for risk mitigation, to some

degree. However, nearly one-half of industry experts said that industry should take a lead role in a sharing arrangement, whereas no more than one-third of any other group took this position.

On average, the experts agreed that the government should have authority over air quality and habitat disruption risks. However, experts did not agree that the government should manage community disruption risks.

The survey results demonstrate a consensus that the debate should focus on developing shared arrangements for seeking sustainable shale gas development, except in areas related to priority risks that require additional research to be fully understood. Areas requiring additional research include, for example, (a) the impacts on surface water and groundwater from the treatment of flowback and produced water by municipal and/or industrial wastewater plants and (b) the impact on air quality due to the venting of methane during fracturing. In these cases, there was a consensus that government should take the lead in addressing the risks.

This report was developed by RFF's Center for Energy Economics and Policy (CEEP) as part of a larger initiative, Managing the Risks of Shale Gas: Identifying a Pathway toward Responsible Development. Updated findings are published at www.rff.org/shalegasrisks.

The CEEP research team worked with hydrologists, geologists, risk assessors, and representatives from industry and environmental groups to develop this survey and analyze the results.

Read the full report at:
www.rff.org/shaleexpertsurvey.

Krupnick, Alan, Hal Gordon, and Sheila Olmstead. 2013.

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