



Policy Brief

Risk Governance Guidelines for Unconventional Gas Development

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Abbreviations used in the text:

IRGC	International Risk Governance Council
NGO	Non-Governmental Organization
UGD	Unconventional Gas Development

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A “revolution” in the energy sector is underway due to technological innovation. Hydraulic stimulation (so-called “fracking”), coupled with horizontal drilling, are expanding the amount of natural gas reserves that are technically and economically recoverable. The process is called “unconventional gas development” (UGD) and it helps capture gas in shales, coal seams, and other difficult locations – sometimes on land, and sometimes offshore. As a result, natural gas production in North America is increasing rapidly, prices of natural gas have plummeted, and companies are gearing up to export natural gas to Europe and Asia.

In this policy brief, IRGC offers recommendations aimed at helping countries around the world make wise decisions about whether to launch programs of UGD. The brief contains nine recommendations to guide the risk governance of UGD. It is accompanied by a major peer-reviewed report that covers the key technical, policy, and political issues and provides complete risk governance guidelines.

The peer-reviewed report is available on [www.irgc.org](http://www.irgc.org/wp-content/uploads/2013/12/IRGC-Report-Unconventional-Gas-Development-2013.pdf) at <http://www.irgc.org/wp-content/uploads/2013/12/IRGC-Report-Unconventional-Gas-Development-2013.pdf>

The International Risk Governance Council (IRGC) is an independent foundation based in Switzerland whose purpose is to advance the understanding and management of emerging, global systemic risks. It does so by drawing on the best scientific knowledge and by combining it with the understanding of specialists in the public and private sectors. IRGC's reports contain fact-based risk governance recommendations for policy makers.

The raison d'être of IRGC is the direct result of widespread concern within the public sector, the corporate world, academia, the media, and society about an increasingly large number of complex risks that pose challenges to adequate risk governance. A particular concern of IRGC is that important opportunities from new technologies are not lost due to inadequate risk governance. When technologies have the capacity to alleviate major global concerns, a failure to adopt them has potentially catastrophic consequences.

The development of natural gas from unconventional sources has boomed in the past decade and is rapidly changing the complex web of global energy production and consumption. The large scale of UGD carries with it potentially great benefits but also the possibility of significant risks. While this emerging technology has the potential to ameliorate emissions of the greenhouse gas carbon dioxide, provide a low-cost source of fuel, and serve as a transition source of energy to renewables, it also has the potential to detrimentally affect ecosystems, land use, water resources and communities. Given the complex benefit-risk calculus, and its likely variation from one region or country to the next, competent governance of UGD is likely to have high value to society.

In November of 2012, the IRGC convened a workshop of international experts to identify the key issues associated with the development of unconventional gas resources and to determine how risks can be effectively identified, assessed, and managed. The results of that workshop, held at the Swiss Re Centre for Global Dialogue, Zürich, Switzerland, and subsequent dialogues and technical reviews, were used to create both this policy brief and an accompanying report.

This policy brief presents a set of recommendations aimed at ensuring competent risk governance of UGD. Readers interested in a more comprehensive treatment of the technical, regulatory, and political issues are encouraged to consult the accompanying report.

IRGC's work on this topic was led by Professor John D. Graham, Dean of the School of Public and Environmental Affairs (SPEA) at Indiana University. The brief and report were also co-authored by Austin Mitchell, Carnegie Mellon University and John A. Rupp, Indiana University. The project has been supported by IRGC's sponsors but all findings and recommendations are the strict responsibility of the authors and IRGC.

Unconventional Gas Development: Promise and Risks



Numerous countries throughout the world are exploring the promise of unconventional gas development (UGD) as a component of national energy policy. IRGC presumes that policy makers seek to maximize the overall well-being of society, taking into account the risks and benefits of UGD compared to the risks and benefits of alternative energy sources. The global interest in UGD has been stimulated by a rapid increase in shale gas development in North America over the past fifteen years.

This policy brief defines UGD as the use of advanced methods of hydraulic fracturing, coupled with directional drilling (i.e., horizontal as well as vertical drilling), to access natural gas resources that were previously considered technically inaccessible or uneconomical to produce. While this brief focuses on UGD from shales, many of the brief's risk-governance recommendations are also relevant to gas development from tight gas sands and coal seams.

UGD provides a variety of benefits. Specifically, development:

- Provides affordable energy to businesses and consumers in the industrial, residential, and transportation sectors;
- Creates direct and indirect employment and economic prosperity;
- Contributes to a country's energy security by lowering dependence on imported energy;
- Provides a basis for a new export industry, since many countries seek to import natural gas;
- Generates fewer greenhouse gas emissions than coal and oil;
- Reduces damages to local environmental quality by replacing some uses of coal and oil with a cleaner alternative;
- Provides a backup energy source to renewables;
- Enhances the competitiveness of a country's manufacturing sector, especially subsectors (e.g., chemicals, steel, plastic, and forest products) that use natural gas as a key input to production.

UGD poses a variety of risks. Threats to human health, safety and the environment are a prominent concern, especially if effective risk-management practices are not implemented. Potential threats include:

- Degradation of local air quality and water resources;
- Consumption of potentially scarce water supplies;
- Habitat fragmentation and ecosystem damage;
- Community stress and economic instability;
- Induced seismic events;
- Exacerbation of global climate change by triggering more emissions of methane;
- Slowing the rate of investment in more sustainable energy systems.

There are a series of known and inferred benefits and risks from UGD, but there may be a variety of other impacts – some positive, some negative – that are not understood today but may emerge in the short run and long run as real world experience accumulates and scientific progress occurs.

Given that there are numerous potential benefits and risks from UGD and given that the balance of benefits and risks may vary in different jurisdictions, policy makers should not assume that all of the components of a policy toward UGD in one country are necessarily a policy model for another country. In fact, countries will vary in whether they choose to take an optimistic or risk-averse posture toward this evolving energy resource and suite of associated technologies. Indeed, the associated full report demonstrates several instances where neighboring countries or states/provinces have adopted starkly different policies toward UGD. Since a uniform policy solution is not applicable in all countries, our recommendations focus on some key questions that policy makers need to address as they formulate their jurisdictionally-specific policies on UGD.

These recommendations are designed to facilitate the establishment of the appropriate balance between a government-led energy policy, industrial development activities, and securing popular (especially local) acceptance.

1. Reserves of natural gas:

Countries should develop better assessments of their reserves.

Before making a broad policy decision for or against UGD, a country needs to do enough exploration and assessment to determine its geological potential to produce gas from unconventional sources. Approximate country-by-country figures are available (see *Figures 1 and 2*), but truly reliable estimates of recoverable reserves – estimates that account for what is both technically accessible and economically recoverable -- are often unavailable. There has been much progress in this realm in the past few years, but significant uncertainty remains. Accurate estimates of the magnitude of these reserves are crucial for intelligent UGD policy making, for wise planning by investors and energy companies, and for gauging how much effort a country should devote to the design of risk governance systems.

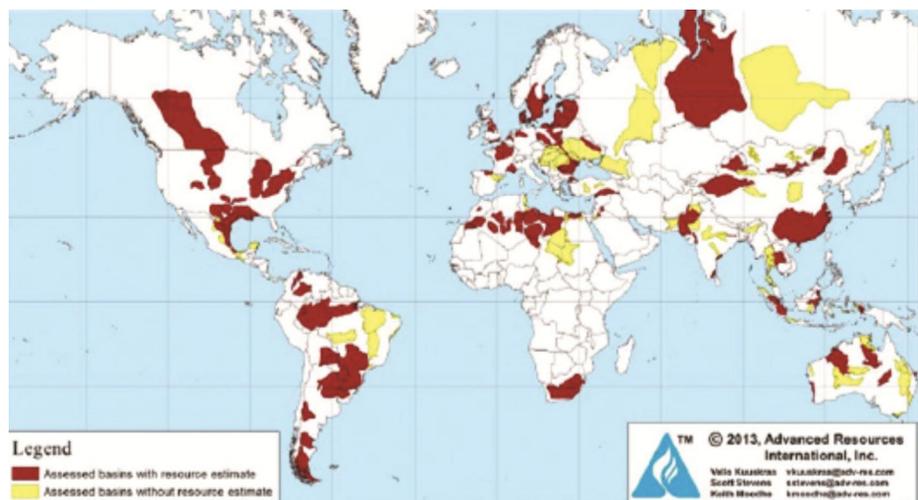


Figure 1: Assessed shale gas and shale oil basins in the world

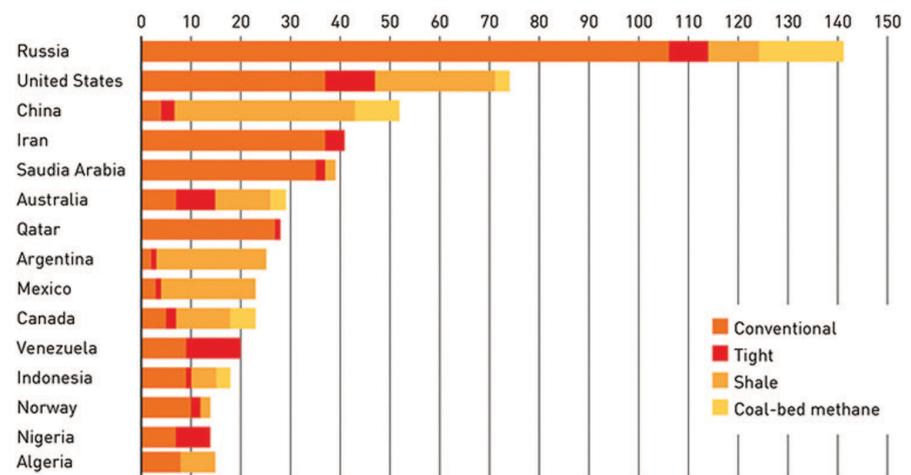


Figure 2: Recoverable natural gas reserves in trillion cubic meters (tcm) in 2011. Based on IEA.

2. Balancing sources of energy:

Once the potential for UGD has been estimated, policy makers should consider and work to balance the risks and benefits of UGD in comparison with alternative sources of energy that are feasible and affordable in the timeframe relevant to meet their needs.

There are multiple sources of energy to support the economies of the developed and developing world, and UGD is only one of them. Since UGD can serve as a bridge technology from today's heavy dependence on high-carbon sources of energy to an ultimately sustainable, low-carbon energy future, a realistic risk-benefit comparison needs to be made between UGD and other bridge technologies. Countries that already have significant programs of nuclear power, hydropower, and renewables are in a different situation than countries that are dependent on coal and/or oil and imported gas. UGD may prove to be more attractive to countries that are now dependent on coal, oil, and imported gas. Policies toward UGD need to be integrated into a long-term path toward sustainable energy. Such policies will provide a meaningful opportunity for all stakeholders to express their viewpoints and influence the development of the portfolio of energy sources.

3. Getting ready for UGD:

If a country envisions a major commitment to UGD, government and industry need to make a sustained investment in necessary capabilities and infrastructure.

The experience from North America shows that, under the right conditions, UGD can occur quickly if adverse impacts are minimized, but it can only be done with the parallel development of supporting industries, capabilities and infrastructure. The expertise to undertake advanced horizontal drilling and hydraulic fracturing is not present in many countries and it will take time for a new UGD industry to develop the appropriate technical support services. UGD requires significant access to fresh water resources and well-developed plans to treat the large volumes of wastewater that are generated at the well. Pipelines or other transport systems are needed to bring water to the well, to bring wastes to treatment and disposal sites, and to bring recovered gas to processing plants and ultimately to industrial and retail customers. Without a cooperative approach by government and industry, it is unlikely that the necessary capabilities and infrastructure will emerge. Wise investors will look for evidence of a cooperative environment between the government and the industry before investing the large amounts of capital needed for UGD, since there are many alternative opportunities around the world to invest in UGD and other energy projects.

4.Environmental risks:

Proper management of environmental risk should be a prerequisite for sustainable unconventional gas development.

When advanced drilling and production techniques are employed, such as horizontal drilling and hydraulic fracturing (see *Figure 3*), there can be serious risks to the environment, especially if best practices are not followed. Many of the concerns that have attracted public attention are related to water contamination, potential pollution of both groundwater and surface water. Potential risks also include risks to climate change if production is done without enough control of methane leakage to the atmosphere or by CO₂ emissions during the production and transportation process. Additional risks include disruption of land uses and generation of seismic events. There may be other long term threats, yet to be identified and understood, including effects of injecting fluids on deep strata or the effects of pressure on the hydrologic system of a region. Although there are risks of UGD, they are generally manageable with state-of-the-art practices and vigilant regulation.

The management of each potential risk and its monitoring -- before, during and after production -- will require careful assessment and mitigation techniques. Appropriate

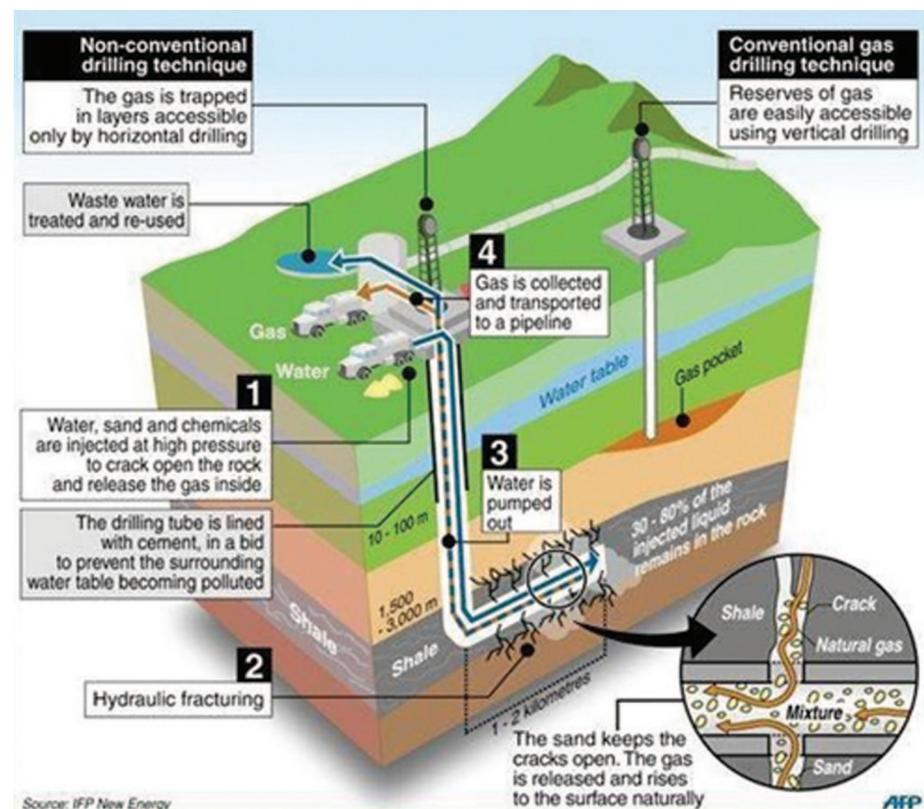


Figure 3: Basic dynamics of shale gas extraction using horizontal drilling and hydraulic fracturing techniques to enhance reservoir performance.

engineering and operational experts need to be involved in the assessment and management of these risks, including contributions by the geological, biological and environmental sciences and the planning communities. The assessment of risks needs to be regionally specific, such that the mitigation actions are both appropriate and proportional to the risks.

In addition to the management of localized risks near wells, countries should clarify how UGD will be implemented in a way that helps meet (or at least does not obstruct) the nation's climate-protection policies. A country may also have obligations under international law that need to be addressed.

Competent environmental risk management is not optional. If the environmental risks of UGD are not managed properly, the activity will not be sustainable, since the public will not tolerate indefinitely significant impacts to water quality, air quality, public health and ecosystems.



5. Community benefits:

Local sharing of the benefits of UGD should be established in some form within countries undertaking UGD.

In areas where UGD is thriving, the monetary gains to developers are shared with community residents and municipalities, as a form of compensation for burdens that are placed on communities in which development is taking place.

In North America, the legal system of private property rights typically allows landowners to share in the profits from UGD, often in the amount of thousands of dollars per household or more. Additionally, state, county and municipal governments, through taxation of UGD, also acquire new revenue sources to address critical public needs such as education and health care. In much of Europe and Asia, the legal systems are quite different. If countries on these continents do not compensate landowners and local communities for land and other facilities used for UGD, the entire process of community participation may turn against UGD, even if UGD is in the country's overall best interests. Recognizing the experience in North America, countries such as the UK, Ukraine, and Poland are refining policies toward UGD to ensure that local communities will reap significant economic benefits from development. Additionally, there is a need to work with and incentivize local authorities, which can be facilitators or obstacles to development. This means applying the right incentives and safeguards so that drilling activity is acknowledged as being of benefit in both the short and long term. There is no single correct procedure for accomplishing community benefit and thus each country must define an arrangement that is compatible with applicable social expectations, legal standards and political values.



6. Regulatory adaptability:

Although a degree of regulatory certainty is critical for developers and investors, the regulatory system should be flexible enough to adapt over time in response to lessons learned in order to better serve the needs of all stakeholders.

These changes need to be based on new scientific knowledge as well as operational experiences and concerns that are specific and appropriate to a region.

No energy resource, developed with new technology, springs forward immediately from the constraints of a comprehensive, finely-tuned regulatory system. The industrial practices develop iteratively in conjunction with an evolving regulatory system, and this evolutionary process needs to be responsive to practical experience, technological innovation, and changing scientific understanding of the risks and benefits.

A degree of precaution is warranted because the long-term, comprehensive impacts of UGD are not yet fully assessed. Since the actual risks of UGD to local communities and ecosystems will vary depending on physical details of the setting and the precise practices of developers, a process of learning occurs as permits are granted, exploration and development occurs, and renewal of permits is negotiated based on learning from experience. Judgments need to be made to determine whether existing oil and gas regulations can be adapted to effectively govern UGD or whether more specific regulations need to be developed. While it is not wise to change the conditions of permits immediately after each incident or scientific study, it is imperative for industry and regulators to modernize the standards of performance in conjunction with the evolution of understanding and documentation of associated risks, to ensure that the terms of permits are up to date with best industry practices, technical advances, and scientific understanding.

7. Public confidence:

A key to earning public confidence in UGD is the establishment of a functional permitting system that assures that operators will comply in a responsible way with health, safety and environmental regulations.

Permits are only granted to developers when they demonstrate that they have both the ability and willingness to comply with applicable health, safety and environmental standards. Equally important in retaining the public trust is the effective operation of a system of inspection and enforcement by the regulators that ensures that the conditions of a permit are complied with and that violations have serious consequences.

In our review of national regulatory systems, we found that successful real-world cases of UGD rely on a combination of a strong regulatory system for governing UGD and voluntary standards, incentives, or pledges to adhere to best industry practices to govern risks. Local public confidence can only be built with careful attention to a community's concerns and expectations, employing effective communication and transparent processes, along with other requirements of good governance. At the core of this relationship is the process by which permits are administered.

In addition to voluntary standards, the permits issued by the regulatory community typically place binding constraints on the behavior of developers, and the nature of those constraints varies depending on the geology of the area, the proximity to rivers and populated communities, the preferences of local officials, and the history of previous developers in the area. The conditions of the permits govern permissible activities of the operator. The critical technical issues addressed include the proper casing of wells, measures to control fugitive emissions of pollutants, proper management of flow-back water and associated wastes, setback requirements to protect schools, health care facilities and neighborhoods, plans to channel truck traffic in ways that minimize community nuisances, and requirements for remediation and monitoring at a site once the well has been plugged. When a permit system is working effectively, stakeholders and the community know that they can participate in the permit process rather than be forced to accept whatever terms emerge from a two-way dialogue between a developer and a regulator. Thus, the permit process is not simply about protecting public health, safety and the environment; it is about inclusion of the concerns of stakeholders, thus building public confidence in the safety of UGD.

8. Effectively engaging stakeholders and communities:

Both industry and regulators need training and organizational leadership in properly engaging community leaders and residents who reside near potential sites of UGD.

The concerns about UGD among regulators, investors, professional environmentalists, and academic scientists are not necessarily the same as the concerns of local citizens and community leaders. When people are affected by a local development, their concerns may not be about such topics as long-term groundwater contamination, climate change or minor changes in seismicity but rather on immediate impacts. Experience shows that a local citizen can become quite concerned about the near-term quality of life in his or her community, and how it might be impacted by factors such as noise, truck traffic, congestion, dust levels, odor, competition for water supplies, fragmentation of forests and habitat destruction, and a possible boom-bust cycle in the local economy as development ramps up and then declines, sometimes precipitously. Rapid changes to daily life in small rural towns that result from the impacts of development may be particularly traumatic and thus difficult for local community leaders to manage. The period of disruption for a community may vary in length from several weeks (initial well drilling and completion period) to years depending on how long a field would be in production. While some of these concerns may be applicable to any industrial development, many of them will apply specifically to UGD, and both industry and regulators need to be prepared to address community concerns in a responsive, patient and professional manner. When community concerns are not addressed effectively, UGD is not sustainable. Thus, frequent dialogue and informed, responsive decision-making need to be an integral part of UGD.

9. Sharing of knowledge and practical experiences:

National, regional and international platforms should be created to share best practices related to UGD.

The capability to effectively undertake UGD, and manage the associated risks, is enhanced when industry and regulators learn from the real-world experiences of others: What baseline data are the most important to collect? How should accidents from operational activities be handled? What training and experience is required to engage in effective community engagement? How can regulatory agencies attract and retain qualified personnel to review permits, conduct inspections and undertake enforcement activities? What are the most sustainable revenue policies for ensuring that regulatory bodies are properly funded? Such questions are being addressed repeatedly throughout the world, but there are few organized opportunities for officials to learn from each other's experiences. Consequently, IRGC recommends independent roundtables be established for the purpose of regional and international information and experience sharing. Scientists, policy makers, regulators, industry and NGOs should interact regularly in a constructive and open manner, for the benefit of all.

These nine recommendations, which are for use by policy makers, regulators, industry and investors, are a simplification of the complete set of recommendations that are further developed and supported in the IRGC peer-reviewed report on risk governance guidelines for unconventional gas development.

The report also includes a complete list of references and a bibliography for further reading.

The International Risk Governance Council (IRGC) is an independent foundation based in Switzerland whose purpose is to identify and propose recommendations for the governance of emerging global risks. Because many emerging risks are associated with new technologies and usually accompany significant economic and public benefits, different governance approaches and policy instruments must often be developed to maximise those benefits while minimising the identified risks. Important opportunities for social and economic development can be foregone where the public perceives inadequate risk governance measures. To ensure the objectivity of its governance recommendations, the IRGC draws upon international scientific knowledge and expertise from both the public and private sectors in order to develop fact-based risk governance recommendations for policymakers, untainted by vested interests or political considerations.

The IRGC peer-reviewed report on Risk Governance Guidelines for Unconventional Gas Development (available on www.irgc.org) is an example of such fact-based objective analysis. It is the result of an IRGC project work, which involved a multidisciplinary team of experts, led by Professor John D. Graham, Dean of the School of Public and Environmental Affairs (SPEA) at Indiana University. IRGC is grateful to all experts and peer-reviewers for contributing their time and sharing their knowledge and thoughts.

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international risk governance council

EPFL
Case Postale 99
1015 Lausanne
Switzerland

tel +41 21 693 8290

info@irgc.org
www.irgc.org

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