Chapter X

Risks Beyond the Well Pad:
The Economic Footprint of Shale Gas Development in the US

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High volume hydraulic fracturing is perhaps the most important industrialization process to occur in the U.S. for decades. This technology, also known as "massive horizontal slickwater hydraulic fracturing", or unconventional gas extraction (UGE) was first used in the mid-1990s in the Barnett shale play of Northeast Texas. It emerged out of many years of experimentation with techniques to profitably obtain oil and gas from shale deposits deep under the surface.

While attractive because of its potential contribution to the U.S. balance of payments and to displace coal in domestic energy production markets, the development of unconventional gas is something less than an unalloyed "good". Those who are advocates of this technology speak of the benefits of the U.S. becoming not only energy independent, but also a major exporter of natural gas, with all the economic and political benefits that this would create. Opponents present cogent arguments pointing to the potentially negative implications for the environment and well-being of the places where shale gas development occurs (Brasier this volume). Too often, however, assessment of the impact of hydraulic fracturing is very narrowly focused. The goal of this chapter is to step back to view hydraulic fracturing through a wider lens, considering its extensive impacts across the American economic landscape.

Unlike, iron ore and coal mining, which are located in less-populated regions, such as Appalachia or the Powder River Basin in Montana and Wyoming, shale gas and oil extraction has a broader national geographic footprint. Extraction is possible in many locations, including areas where extractive industries have existed for generations, and others where extraction is a new phenomenon. Urban and suburban communities may be sites for hydraulic fracturing as well as the more stereotypic rural, less-populated locations. In addition, the processes associated with providing the inputs to hydraulic fracturing and disposing of the toxic materials produced in unconventional gas extraction affect many cities and regions not directly engaged in the extraction process. To fully understand the implications of high volume hydraulic fracturing on the US economy we need to look beyond the well pad. Specifically, what can previous experience tells us about the regional economic impacts of extraction-based resource development? What types of local economies are affected by the industrial processes connected to hydraulic fracturing? How are the differences among those places likely to alter the nature and extent of the impacts? How is hydraulic fracturing affecting regional economies where no shale gas or oil development is taking place?

Because unconventional gas extraction takes place in many different types of environments, impacts will vary and be more “visible” in some places than others. One of the challenges in systematically identifying and accounting for economic impacts is taking into account this variability. For example, some impacts, such as increases in public safety costs relate to an increase in crime, are more visible in isolated communities (e.g., Dickinson North Dakota) that fit the traditional depiction of the “mining boom town”. In urban locations, such as Denton Texas, an increase in crime may be absorbed in broader regional metropolitan patterns and not be as visible. Other types of costs, such as traffic accidents and congestion, may be intensified in suburban or urban extraction locations but have less of an impact in rural areas.

The systematic analysis of economic impacts is hampered by a lack of baseline data from which to monitor change. With the exception of county crime statistics, maintained by The Federal Bureau of Investigation under the Uniform Crime Reporting Statistics program, there are no data compilations that support comparison of social or economic impacts across counties. Because of different modes of reporting well permitting, production and completion across states, it is not possible to analyze the pattern of economic impacts and public costs as it relates to the progress of the drilling cycle. Data definitively documenting how localities are affected by shale gas and oil development are currently not available because neither the states nor the federal government have been willing to collect it. Data, if available at all, must be assembled state-by-state, county-by-county or agency-by-agency.

Even when data are collected, the lack of comparative statistics across states and localities makes a systematic analysis of the different types of impacts almost impossible. For example, a recent small comparative study of monitoring of public health complaints arising from UGE in three states found that Wyoming did not record any health complaints; North Dakota has started recording complaints but the data are not made public; and, Colorado, in contrast, both records complaints and makes them public.[1] As such, the absence of data on impacts has hampered states' ability to not only realistically assess the costs of UGE development but also impose impact fees or taxes to compensate for potential losses.

Despite the absence of statistical data, there is a growing body of literature that documents similar economic impacts among localities in different shale plays and in natural resource extraction economies. This literature includes: environment impact statements, public policy reports, academic journal articles and eyewitness accounts by journalists. In some cases, there are multiple accounts of economic impacts in the same area at different points in time; e.g., Sublette County Wyoming and Williston, North Dakota. This literature forms the evidence used in this paper.

This chapter discusses what is known about the economic impact of resource extraction on regional economies, with particular attention to what has been learned about UGE economies in U.S. shale plays. An examination of the different types of regions impacted by UGE will be presented, including how differences among those regions may affect the range, visibility, and intensity of economic impacts. Finally, I broaden the lens to look at how regions outside the UGE extraction areas are impacted by the national industrialization process and what a wider perspective implies for policy.

What We Know About The Economic Impacts Of Resource-Based Extraction Economies – The Boom-Bust Cycle

The U.S. has a rich lore of "boomtowns" and "ghost towns," yet people rarely connect this history -- and the boom-bust cycle it depicts -- to contemporary resource development.[2,3,4] Today's unconventional gas extraction using horizontal drilling and high volume hydraulic fracturing is both similar to and different from previous experience. UGE undoubtedly will produce a cycle of boom and bust at the local level. Like any nonrenewable resource development, shale gas development does bring an economic "boom" to extraction regions, at least during the period when drilling sites and support facilities are set up and drilling takes place. As drilling companies move into a community, population flows in for employment or to "cash in" on the boom. Local expenditures rise on everything from auto parts to pizza and beer. There also is an increase in jobs outside the extraction industry itself in construction, transportation, retail, hotels and restaurants, entertainment and services.[5,6]

Landowners receive royalty payments and have extra money to spend. The tax base may expand, providing a windfall for a local government. However, research on actual employment impacts in resource development regions indicates that job projections are typically over-stated.[7,8] For example, in the seven states in the U.S. with over 5,000 employees in the oil and gas extraction industry (Texas, California, Oklahoma, Pennsylvania, Colorado, Louisiana and New Mexico) the percent of state employment in the oil and gas industry is well under 1% of total state employment.[9] Although employment increased between 2002 and 2012 in these states, the *percentage* remained under 1% except in Oklahoma where it totaled 1.5% of total state employment in 2012.[10] The high growth rates used to indicate the industry contribution to employment are often stated in percentage terms, ignoring the reality that the industry employs very small numbers of people.

Notwithstanding the exaggerated estimates that abound about job impacts, the increased economic activity associated with UGE is welcome in some communities, especially among individuals who are expecting or hoping to reap direct economic benefits. However, while a natural resource extraction boom may bring jobs and population growth for a few years, it also increases public service costs and the cost of living for residents, and "crowds out" other industries and may raise their cost of doing business.[11] In the case of UGE, these other industries may include tourism, retirement communities, manufacturing, or organic agriculture.

Shale gas development also brings an additional level of uncertainty to regional economic forecasting. Since a substantial number of U.S. states are engaged in shale gas and oil extraction, some producing dry gas and some with higher-profit oil deposits, drilling rigs may move at short notice from one region to another, causing a series of economic disruptions as drilling starts up, shuts down, and then starts up again.[12] This phenomenon has been affecting Pennsylvania since 2012. After a several year boom, rigs and jobs have disappeared from the state, leaving some areas with uncompleted wells and sharply reduced fees and to pay for the projects they started during the boom period. Natural gas rigs in Pennsylvania have dropped from a high of 112 operating in the state in 2011 to 51 in August 2013. [13]

This process of unpredictable boom and bust is inherent to resource extraction economies. Boomtowns frequently experience problems brought about by the influx of a transient population that follows the oil and gas industry rigs from one place to another. After the boom ends (either temporarily or permanently) and the drilling crews and their service providers depart, it is not inconceivable that the region may have a smaller population and a poorer economy than before the extraction industry moved in.[14] If the boom-bust cycle is combined with environmental damage, the long-term costs to regions hosting shale gas and oil extraction may be considerable because they will limit future investment and tourism.

What does all this mean? Essentially, natural resource development -- including unconventional gas extraction -- is positive for some segments of the population (mineral rights owners, some businesses) and negative for others (renters, land owners without mineral rights, businesses in competing industries). When the commercially viable resources are depleted, drilling ceases -- either temporarily or permanently -- and there is an economic "bust", as businesses and personnel connected to resource extraction leave the community.[15,16] Mineral rights owners may continue to derive royalties from their lease, but the impact of those royalties on the regional economy is unclear.[17] Mineral rights lease-holders may not reside in the region or may invest rather than spend their royalties or may spend their royalties outside the region. So, in addition to issues related to the boom-bust nature of economic development in UGE regions, there are complex questions about how the boom period economic benefits are distributed in the population and geographically.

Looking Regionally: Production Sites May Not Reap Economic Benefits; Costs May Be Displaced

While jobs are created in drilling regions, evidence shows that most well site jobs go to outsiders --drilling contract companies. [18] Local residents get some jobs in support of drilling activity (e.g., in lodging, food and entertainment, or retail services), but most high paying jobs go to those who are brought in to drill the wells.[19] Moreover, jobs may not be created in the communities where hydraulic fracturing is occurring. That is, they may be created in another county, or another state. This will become clearer in the subsequent pages.

The complex regional character of UGE on the economy is well illustrated by what is happening in the Marcellus Shale, specifically in Northern Pennsylvania and the Southern Tier of New York. While drilling activity is confined to the Northern Pennsylvania counties (because there is a moratorium in drilling in effect in New York State), many of the economic benefits associated with UGE accrue to the Southern Tier New York counties primarily because these counties have commercial facilities, including hotels, restaurants, and retail establishments in place. Sales tax receipts in the New York counties along its southern border with Pennsylvania increased at the highest rate in the state during the height of the drilling boom from 2010-2012.[20] This displacement of economic benefits from the neighborhood of the drilling sites to other locations in the regional economy, part of which is in another state, demonstrates an important principal of economic impacts related to resource extraction. It is not where the drilling activity occurs per se, but where the expenditures are made that determines the location of economic benefits from resource development-driven industrialization.

The complexity of predicting where benefits of UGE will occur also applies to the costs of natural gas development. UGE is a regional and national industrial process and the costs of natural gas development may affect places far from the well sites. State and local governments --- counties, cities, townships, villages --- in states where UGE is taking place are coping with demands for new services and increased levels of service. The administrative capacity, staffing levels, equipment, and outside expertise needed to meet those demands may be beyond what has been budgeted. In Sublette County Wyoming, for example, as the number of gas wells drilled *per year* climbed from 100 in the year 2000 to more than 500 in 2006, the population of Sublette County swelled by 24%. During that same period, Wyoming's population grew by just 4%, indicating that workers and their families were flocking to the area to meet the new labor demand. The most dramatic increase in population came from teens and young adults age 15 to 24, and even as adults age 25 to 44 were decreasing statewide, they were increasing in the County. Indeed, all cohorts of working age adults increased more rapidly in Sublette County than statewide.[21] This short-term population influx created significant demands on public services.[22]

Both the Sublette County experience and the now well-documented experience of North Dakota communities of Dickinson and Williston [23] indicate that UGE increases a wide range of public service costs, many paid for at the state level. In Sublette County, Jacquet[24] found that traffic on major roads increased, as did the number of traffic accidents, the number of emergency room visits, and the demand for emergency response services. In addition, local schools experienced increased demand, as some workers moved their families to the region and had to enroll their children in school. And, as demand for all manner of goods and services increased and local businesses sought to exploit the boom, prices went up --- not just for temporary residents, but for long-time local residents as well. He found that local prices in Sublette County increased by twice the national rate over a six-year "boom" period.

The price inflation characteristic of shale boom areas especially affects rental housing. The drilling boom period in Williston, North Dakota brought an instant population influx similar to that in Sublette County Wyoming, leading to a homeless rate above 20%.[25, 26] Unfortunately, Williston has experience with the boom-bust cycle of oil and gas development, and that experience has discouraged investment in the housing needed for the influx of workers. Developers have been slow to build more apartments, largely because they were stung by the region's last oil boom that went bust in the 1980s.[27] The available evidence indicates that this largely rural region is having difficulty maintaining public services and public safety in the face of boom-town conditions.[28] The costs of this boom, however, are not all paid in Williston. Much is displaced to the State.

Again unexpectedly, a rapid increase in UGE activity is not always associated with a commensurate increase in *resident population* in the counties where the drilling occurs. An analysis of population change in core natural gas drilling counties in the Marcellus Shale during the first decade of the 2000s, for example, indicates that the resident population in these largely rural counties has grown marginally if at all.[29] There are various reasons why resident population growth does not occur in the core counties; the most frequently cited are the absence of services, the higher cost of living, and the lower quality of life in an industrialized environment. A reporter interviewing drillers who resided in neighboring New York State but worked in Pennsylvania captured the reason in one quote:

> *"There is nothing there* [in Pennsylvania]— *there's no entertainment, there's nothing to do…Chemung County"* [in New York State]*is where we spend our money."*

When the 2012 decline in drilling for gas occurred in Northern tier counties of Pennsylvania, with rigs and crews leaving the area, it was the Southern Tier of New York State that experienced a loss in sales tax revenues and customers. Southern Tier New York counties went from having the fastest growing sales tax revenues in the State of New York to, in 2013 and 2014, having steep declines in sales tax revenue.[31]

Thus, when we think about the impacts of UGE, we see that there is no natural congruence between UGE and the economic benefits or costs of gas development. Moreover, because UGE and its associated supply chain activities take place in so many different types of regions, analyzing and evaluating UGE impacts is quite complex. The next section describes some of this complexity and its implications.

Regional Impacts Across a Complex Fracturing Landscape

When one looks beyond the well pad to assess how hydraulic fracturing affects places – communities and regions- one may be surprised at *where* things happen but also at the *geographic extent* of UGE. Although media attention generally is focused on the well site and the immediate neighborhood of households or on the local municipalities and hamlets adjacent to the drilling sites, an extensive multi-county region can be affected by the on-set of drilling activities.[32] For example, the farming and ranching region above the Bakken Shale extends across North Dakota and Montana as well as two Canadian provinces, Manitoba and Saskatchewan. This large region includes small cities that are within the shale play (Williston and Minot, North Dakota). There are other small cities (e.g., Dickinson, North Dakota) that are outside the shale play but which are strongly affected by the economic and industrial activities connected to UGE in the Bakken play. While well pads are located in specific areas, the UGE process also includes staging areas, pipelines, compressor stations, storage facilities, rail trans-shipment sites as well as thousands of trucks hauling chemicals, water, and the contaminate waste produced by the drilling process. Rural roads previously used primarily by farmers now have eight hundred trucks traversing them in a single day![33] Flowback and produced water from the wells has to be transported to treatment facilities, which must be equipped to handle the increased volume and particular array of toxic and non-toxic wastes, or to injection wells. The facilities required will be located where geologic or logistical factors dictate; but, as described in more detail later in the chapter, these operations may touch communities hundreds of miles from the drilling regions, often in another state.

UGE industrial facilities create a wide range of intersecting environmental, economic, and social stressors, all of which have implications for the regional economy and its existing industries.[34,35,36] For example, noise is a major byproduct of compressor stations, which produce noise levels in the 85 to 95 decibel range.[37] These levels more often are at or above the U.S. Occupational Safety and Health Administration (OSHA) threshold of safety for an 8-hour day, and compressors work a 24-hour day. Environmental stressors can have an effect on the nearby population, adjacent property values, and on other industries in the vicinity, including those in adjacent urban neighborhoods.

One example of the impact shale development facilities may have on an urban or rural UGE industrial region is illustrated by the proposed gas storage facility in the Finger Lakes region of New York State, a major area for tourism because of its scenic beauty, small towns and commercial vineyards. This facility, designed to have underground storage to hold 1.45 billion cubic feet of natural gas, is being planned by Inergy Midstream, LLC at the former salt plant just north of Watkins Glen, New York. There are plans to add an underground liquid propane storage facility designed to hold almost 89 million gallons, and two large brine ponds above ground. The site for this major facility is near the intersection of two gas transmission pipelines. But Watkins Glen, in largely rural Schuyler County, is not part of the 'fairway' --- the purported 'sweet spot' for Marcellus drilling in New York—and is many miles from the extraction sites in Pennsylvania whose production it would store. This storage site would not benefit from taxes or impact fees obtained from extraction sites in Pennsylvania, but it will have infrastructure impacts in New York and will require professionally-trained public sector emergency personnel to be located in Watkins Glen.

Whatever the plant may contribute in the way of local property taxes, the Watkins Glen economy and its jobs currently depend on Finger Lakes tourism, attendance at its famous auto races, the local wine industry, and agriculture. Local residents and businesses are concerned that this storage facility poses environmental risks, including the possibility of explosions. There are also risks from leaks from the facility and brine pond seepage or overflow that may affect the quality of water in Seneca Lake, which provides drinking water to thousands of Central New York residents. Finally, tourist businesses and wineries fear the negative reputational effects that this type of industrial facility will have on important local businesses, especially the wineries. For all these reasons, Watkins Glen is a center of opposition to UGE despite its location in a state where UGE is not currently permitted.[38]

To some extent, this opposition can be explained by the changing character of and residential patterns in "rural" counties. Although Schuyler county is rural, by conventional definitions, with a population of about 20,000, many residents commute to work in the more populous and urban neighboring Tompkins County located to the west of Schuyler. They have jobs unrelated to agriculture or extraction industries and have purchased homes in Schuyler County because of amenities such as its wineries and its scenic beauty. Many oppose the natural gas storage facility because they strongly believe that it will affect the quality of life that drew them to this rural county in the first place.

The Imagined and Real Landscape of Hydraulic Fracturing

When people think about UGE, they picture isolated places that are sparsely settled and far from cities and suburbs. However, rural counties (e.g., counties not adjacent to metropolitan area counties) currently compose only half of the U.S. counties where shale gas and oil extraction is taking place.[39] This leaves another half that are classified as metropolitan or micropolitan, places that also experience the boomtown impacts of UGE development. It is important to understand that UGE is either planned for or is on-going in at least 28 states in areas that are characterized by many different types of economic and environmental regions, including rural and semi-rural residential neighborhoods and communities. As was described, the transport of natural gas and its by-products traverses many rural and urban areas. As a consequence, it is fair to state that shale gas development is not limited to one small area.

The boomtown character of development in the energy extraction regions is aptly demonstrated by Census Bureau estimates of the fastest growing metropolitan and micropolitan (between 10,000 and 49,999 residents) in the U.S. Of the 10 fastest-growing metropolitan statistical areas, six were within or adjacent to oil and gas fields. They include: Odessa, TX; Midland, TX; Fargo, ND; Bismarck, ND; Casper, WY and Austin-Round Rock, TX.[40] Among micropolitan statistical areas (relating to an urban area with a population of at least 10,000 but less than 50,000), seven of the fastest growing were located in or near oil and gas plays, with Williston, ND, ranked first in growth, followed by Dickinson, ND, and Andrews, TX. Again, it needs to be recognized that these micro areas have very small populations in actual real numbers. For example, Williston's population rose from 14,716 to 18,532 in 2010-2012, with estimates of another 11% rise in 2012-13.[41] While this may make Williams County, North Dakota one of the fastest growing town in the U.S., the actual population is a fraction of that in the vast majority of U.S. metropolitan counties.[42] As was described in the previous section, the boom-bust character of resource extraction suggests that the micropolitan communities will shrink in size once the drilling phase of extraction is completed.

Thus, when we try to understand the impacts of UGE on communities and regions, we need to consider the scale of development in the region *before* gas drilling and the capacity of the community to absorb the costs that accompany development. In cities, such as Fort Worth or Denton, Texas, where UGE has been extensive, there were emergency services and public safety personnel in place before the drilling boom. There is also rental housing stock to absorb workers migrating into the region and full-time professional managers in city offices charged with governing UGE development. In micropolitan areas, however, city managers often work part-time and emergency personnel may be made up of resident volunteers. On the other hand, some impacts, such as road congestion, noise from compressor stations and citizen complaints, are likely to be intensified in urban UGE areas. These two different environments have different capacities to address the impacts of UGE but also experience the impacts and costs in different ways.

Visible and Invisible Public Costs

One of the most visible costs of UGE relates to the transport of inputs - water, chemicals, heavy equipment and construction materials - to the drilling sites, and outputs, particularly contaminated waste from the drilling site. Well over a thousand truck trips, many by very heavy vehicles, are required to service one well site. These trucks travel over long distances and negatively affect state as well as local road infrastructure. In the states in which estimates are available, the cost of maintaining local roads exceeds the amount received from oil and gas severance taxes.[43] In Texas, for example, in 2012-2013 it was estimated that the state would receive $3.6 billion in severance taxes from oil and gas production; however, the Texas Department of Transportation estimated that the damage to roads from drilling operations totaled approximately $4 billion.[44]

Costs related to public safety are not inconsequential. An analysis of six states with UGE operations found that traffic accidents quadrupled with a concomitant increase in fatalities.[45] Jacquet, too, found that in Sublette County, Wyoming traffic on roads increased, as did the number of traffic accidents, the number of emergency room visits, and the demand for emergency response services.[46] Increases in traffic accidents and citations of commercial vehicles have also been documented in Ohio counties where UGE industrial development has occurred. Ten of the 14 counties experienced increases that exceed the state average rates.[47] In combination with statistics on crime in these same counties, the shale gas development counties were found to be less safe than they were before UGE development.[48] Using the Uniform Crime Statistics database, James and Smith, in a multi-county study of shale gas development regions in the U.S., found that between 2000 and 2012 UGE counties experienced faster growth in reported crimes, including violent crimes, than the U.S. average.[49]

Impacts Beyond The Drilling Regions

While there are demonstrated local or regional impacts of UGE, there are more distant impacts that also need to be addressed. UGE requires quantities of chemicals, sand, and water, which have to be trucked to the drilling site. With the exception of water, these products generally come from areas far from drilling sites. The proliferation of sand mining in Western Wisconsin and Eastern Minnesota, for example, has transformed what were once small rural towns whose economies centered on agriculture and tourism to mining centers providing sand (silica) to distant drilling sites. The local population in these centers is divided over the environmental and public health hazards of silica dust.[50,51]

Fracking fluid, waste water, and other liquid waste, byproducts of the UGE process, must also be disposed of safely. The current primary method for disposal of contaminated water is the injection well, a bored or drilled shaft that inserts fluid deep underground into porous rock formations. Like many of the environmental, health and safety issues associated with UGE, the role of injection wells needs to be understood in the broader context of the extraction process as a whole.[52,53] The U.S. has approximately 680,000 waste and injection wells for disposal of hazardous waste. While this method of disposal has been used for decades, the 21 billion barrels of contaminated water produced in a year clearly exceeds the current supply of disposal sites. Further, many of the existing injection wells are located far from the drilling sites. For example, two of Pennsylvania's injection wells are located in the far northwestern corner of the state on the border with New York State while the overwhelming majority of wells in Pennsylvania are located in the central, northeastern, and southwestern part of the state.

Much of Pennsylvania's contaminated water is also trucked to neighboring Ohio's injection wells.[54,] In 2012, Ohio injection wells handled 588 million gallons of waste water, the majority of which was received from Pennsylvania.[55] However, Ohio is beyond capacity to handle wastewater from Pennsylvania. The disposal of toxic waste from UGE in Pennsylvania and Ohio may include a wider range of far-flung sites including injection wells in Gulf Coast states. Waste materials will be transported to these injection wells via barges on the Mississippi River. Because of the search for new locations for unwanted drilling outputs, one of the most widely geographically distributed products of UGE development may be toxic waste.

Although the oil and gas industry has emphasized trends to recycle waste water, the well servicing businesses have been unable to find a technology that will enable them to profit from recycling and the recycling alternative is largely considered a failure. Less than 10% of shale oil and gas field well water is recycled and there is no expectation that this will increase.[56]

Wherever they are located, injection wells hold their own distinctive risks and environmental costs. For example, injection wells located in central and eastern U.S. states are now being linked to increased seismic activity in regions of the U.S. that previously experienced few earthquakes; e.g., Ohio. Recent scientific evidence on humanly induced seismicity indicates that injection wells may be associated with earthquakes many miles (up to to 50 kilometers) from the wellbores.[57] The hazards from induced seismicity can impact dams, nuclear power plants and other critical facilities.

A second geographically dispersed risk associated with by-products from the drilling process is that of solid waste, deep underground tailings and sludge byproducts. The tailings may have unusually high concentrations of naturally occurring radiation (NORMs), particularly Radium 226, which implies an unusual disposal risk for landfills, the overwhelming majority of which cannot manage hazardous waste safely. In addition to receiving millions of gallons of wastewater, Ohio also receives hazardous waste from UGE for disposal. Perhaps ironically, tailings from Pennsylvania are also being transported to New York State despite the fact that UGE is not permitted in that state.[58] Solid waste is deposited in landfills in multiple New York counties that were once used for local waste deposit but now have become major deposit sites for hazardous waste produced at the Pennsylvania drilling sites.

The evidence concerning present and future contaminated waste disposal demonstrates that risk-bearing activities associated with the drilling process may occur far from the drilling sites, including in areas where drilling is highly regulated or prohibited. And, as the Ohio case demonstrates, disposal risks are being concentrated in particular regions creating another set of distinctive risks, different from those created in drilling sites. Thus, the geography of UGE is complex, with particular states and regions bearing more differentiated risks than others.

One reason for the distribution of UGE-related activities is geologic. Some areas offer better conditions for containing UGE waste. Another reason explaining the UGE footprint, however, is fragmentation and differentiation of regulations governing the interrelated activities in the UGE process. This fragmentation allows for “venue shopping” to find less regulated locations for the disposal of toxic wastes.

In summary, this chapter has tried to show that the footprint of UGE is local, regional, and national. The drilling may be in one small rural area, but the ripple effect goes far beyond that. While the well pad may be the locus of production, the environmental and economic costs of servicing the well site are distributed in a complex production chain that stretches across the U.S.

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