

A NATURAL GAS EXTRACTION POLICY ALTERNATIVES MATRIX

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This document is presented as a companion piece to the publication, “Natural Gas Extraction: Issues and Policy Options” a policy brief (Policy Brief 2/February 2013) also published in 2013 by the National Agricultural and Rural Development Center, and written by the same authors.

Volumes could be written about the potential policy responses available to address the issues presented in this paper. However, the authors have worked to provide a sample of both the issues presented by natural gas extraction activities and the policy alternatives that have been or could be used to address those issues. It should be noted that while examples of implementation of these alternatives have been provided in many cases, the authors do not wish to convey those examples as *exemplary*. In many regions of the U.S., the natural gas extraction industry, in its modern form with a high reliance upon hydraulic fracturing and horizontal drilling, is relatively new. As a result, the objective and peer-reviewed body of scientific literature regarding the efficacy of such measures in reaching their stated goals is small, but growing. The matrix can be used by policy makers to zero in on options to explore for their relevance to the concerns at hand in their jurisdiction.

To save space, the following abbreviations are used in the matrix:

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act

EPA: U.S. Environmental Protection Agency

HF: hydraulic fracturing

NG(E): natural gas (extraction)

NORM: Naturally Occurring Radioactive Material

NRDC: Natural Resources Defense Council

RCRA: Resource Conservation and Recovery Act

SGEIS: Supplement Generic Environmental Impact Statement

VOC: Volatile Organic Compound

Cover Photo: Deep Well Natural Gas Rig, Casper, Wyoming
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<http://www.blm.gov/wo/st/en/bpd.html>



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General Environmental Issues

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
General concerns regarding hydraulic fracturing issues / insufficient information for regulation	Moratorium on hydraulic fracturing (HF) operations pending investigation/research	<ul style="list-style-type: none"> <input type="checkbox"/> “Freezes” development allowing time to gather additional information and stakeholder input. <input type="checkbox"/> Postpones economic benefits <input type="checkbox"/> Issue of counties’ and municipalities’ authority to enact 	<ul style="list-style-type: none"> <input type="checkbox"/> State: New Jersey (1 year moratorium by Gov. Christie in conditional veto of S-2576 on 9/15/2012)¹ <input type="checkbox"/> State: New York (Exec. Order 41 blocks permitting of HF wells pending completion of SGEIS)² <input type="checkbox"/> Buffalo, New York municipal ban³ <input type="checkbox"/> Municipality: Morgantown, WV (moratorium judicially overturned)⁴
Habitat fragmentation	Require / incentivize production of larger area from one well site through increased size of well spacing units and/or increased utilization of multiple-well drilling by horizontal drilling	<ul style="list-style-type: none"> <input type="checkbox"/> Reduces overall land use and fragmentation by producing larger area from one well site <input type="checkbox"/> Increases spatial impact on surface estate where larger well site is located <input type="checkbox"/> Increased unit size may be contested by mineral owners as decreasing their proportion of unit ownership <input type="checkbox"/> Increased use of horizontal drilling may exacerbate other concerns 	<ul style="list-style-type: none"> <input type="checkbox"/> Oklahoma Corporation Commission spacing rules⁵

Water Quality and Quantity

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Quantity of water used for natural gas extraction (NGE)	Measurement and monitoring of water used for NGE / cap on maximum use / encouragement of recycled water use	<ul style="list-style-type: none"> <input type="checkbox"/> Enables collection of data re: NGE water use <input type="checkbox"/> Question of who pays for monitoring / enforcement of cap <input type="checkbox"/> Question of how limits are set <input type="checkbox"/> Cap may restrict NGE activities and economic benefits <input type="checkbox"/> Water recycling technology developing quickly, but may not be widely available 	<ul style="list-style-type: none"> <input type="checkbox"/> Colorado Department of Natural Resources Groundwater Diversion Regulations⁶ <input type="checkbox"/> API Water Management Associated with Hydraulic Fracturing – guidelines for water management, recycling & disposal⁷
	Restrictions on time / amount of water withdrawals for NGE	<ul style="list-style-type: none"> <input type="checkbox"/> Can time-shift withdrawals to avoid acute impacts to other uses (aquatic habitat, agriculture, power, etc.) <input type="checkbox"/> Requires understanding of region's hydrologic cycle; dependent on rainfall and other variables <input type="checkbox"/> Seasonality can make NGE development more expensive; delays may be costly 	<ul style="list-style-type: none"> <input type="checkbox"/> State of Michigan Department of Natural Resources Report (discussion of impacts based on seasonality)⁸
	Differential water pricing based on use (premium for water used for NGE)	<ul style="list-style-type: none"> <input type="checkbox"/> Can increase revenues for water supplier (if pricing does not discourage use) <input type="checkbox"/> Can link revenues and costs of expanding water supply <input type="checkbox"/> High probability of contest by NG developers if rates are different from other industrial users 	<ul style="list-style-type: none"> <input type="checkbox"/> Proposed by City of Carlsbad, NM 1/8/2013⁹
Surface spills of fracturing fluid components / blowback / produced water	Require secondary containment around all storage areas and/or enhanced requirements for storage vessels and pits	<ul style="list-style-type: none"> <input type="checkbox"/> Reduces probability that spills reach surface/groundwater sources <input type="checkbox"/> Requires development of standards <input type="checkbox"/> Question of who pays for inspection/enforcement <input type="checkbox"/> Restricting use of earthen pits may mean use of portable storage units, which can increase truck traffic and risk of accident/roadside spills 	<ul style="list-style-type: none"> <input type="checkbox"/> Proposed requirement for closed storage systems in New York SGEIS¹⁰ <input type="checkbox"/> Oklahoma Corporation Commission specifications for drilling fluid storage/disposal pits¹¹
Impacts from injection of fracturing fluids	Specify requirements for well construction, casing/seal requirements, pressure testing	<ul style="list-style-type: none"> <input type="checkbox"/> Can prevent formation of artificial pathways connecting hydrocarbon formations and groundwater formations <input type="checkbox"/> Requires extensive technical knowledge to develop and implement <input type="checkbox"/> Only effective to extent requirements can be monitored, enforced and evaluated; question of who pays 	<ul style="list-style-type: none"> <input type="checkbox"/> Texas Railroad Commission specifications for casing, cementing, drilling, and completion requirements¹²
	Regulation of HF through Underground Injection Control program of Safe Drinking Water Act	<ul style="list-style-type: none"> <input type="checkbox"/> Requires federal legislative action <input type="checkbox"/> Would increase federal authority to regulate HF activities (increases state authority under delegated programs) <input type="checkbox"/> Would represent significant change in federal policy/cost of enforcement 	<ul style="list-style-type: none"> <input type="checkbox"/> FRAC Act¹³
	Establish baseline testing requirements for water resources near HF wells	<ul style="list-style-type: none"> <input type="checkbox"/> Can aid understanding of impacts (if any) of HF operations on local water quality <input type="checkbox"/> Must be used in concert with other scientific investigations <input type="checkbox"/> Costly to implement and maintain <input type="checkbox"/> May be "too late" if HF operations already commenced 	<ul style="list-style-type: none"> <input type="checkbox"/> Colorado Oil & Gas Conservation Comm'n Groundwater Protection Rule¹⁴ <input type="checkbox"/> Pennsylvania Act 13¹⁵
Use of toxic substances	Ban use of toxics in fracturing fluids	<ul style="list-style-type: none"> <input type="checkbox"/> Eliminates concern of introduction of toxics to environment through HF activity <input type="checkbox"/> May block HF operations in some areas if non-toxic substitute not available 	<ul style="list-style-type: none"> <input type="checkbox"/> Research unable to find any bans currently in place
Disclosure of fluid components	Enact requirements for disclosure of fracturing fluid components, amounts and concentrations	<ul style="list-style-type: none"> <input type="checkbox"/> Significant voluntary efforts already in place <input type="checkbox"/> Facilitates public dialogue re: potential impacts of fluid use and development of regulatory systems <input type="checkbox"/> Disclosure of information deemed "trade secret" may result in legal challenges 	<ul style="list-style-type: none"> <input type="checkbox"/> Voluntary disclosure program through www.fracfocus.org <input type="checkbox"/> Pennsylvania state disclosure requirement¹⁶
Inadequate treatment of wastewaters	Increase requirements for pretreatment of waters sent to POTWs for final treatment and discharge / prohibit discharge of wastewaters to POTWs	<ul style="list-style-type: none"> <input type="checkbox"/> Shifts portion of treatment efforts and costs from POTWs to NG developers <input type="checkbox"/> May significantly increase costs of NGE <input type="checkbox"/> Requirement for NG developers to treat waters on-site likely requires additional equipment, increasing wellpad size, risk of on-site spills, and truck traffic 	<ul style="list-style-type: none"> <input type="checkbox"/> Proposed federal requirement for increased pretreatment of wastes¹⁷ <input type="checkbox"/> New York proposed prohibition of discharge of NGE waters to POTWs¹⁸ <input type="checkbox"/> New Jersey general ban on treatment of HF waste¹⁹

Air Quality

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Emissions from wellbore	Require increased controls at all stages of drilling and production under “green completion” system	<ul style="list-style-type: none"> <input type="checkbox"/> Can reduce emissions by requiring capture or combustion of gas emissions that might otherwise escape during well completion process <input type="checkbox"/> Must develop technical specifications for capture or control mechanisms <input type="checkbox"/> Increases cost of NG well development 	<input type="checkbox"/> Federal requirement enacted but implementation currently in abeyance pending review by EPA ²⁰
Emissions from supporting equipment	Specify requirements for operation of engines and generators (limiting hours, requiring emissions controls, etc.)	<ul style="list-style-type: none"> <input type="checkbox"/> Address point-sources of air pollutants; potentially least-cost and most easily implemented pollution control <input type="checkbox"/> Hour restrictions can make NGE activities difficult; may have effect of “trading” chronic emissions for acute emissions 	<input type="checkbox"/> Federal requirements stationary compression ignition internal combustion engines ²¹
Emissions from storage of flowback and produced water	Require flowback and produced water to be kept in closed vessels; require emissions controls for venting of gases from storage	<ul style="list-style-type: none"> <input type="checkbox"/> Reduces overall emissions <input type="checkbox"/> Transforms fugitive emissions into more manageable point-source emissions. <input type="checkbox"/> Emissions from these sources not yet fully understood; need to adapt emission control requirements from other programs to fit emissions from closed storage of flowback and produced water <input type="checkbox"/> Management through closed vessels can be difficult if high volumes of flowback and produced water are encountered 	<input type="checkbox"/> Regulation of VOC emissions from storage tanks. ²²

Solid Waste Disposal Issues

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Disposal of drill cuttings and used drilling mud	Establish standards for disposal of wastes	<ul style="list-style-type: none"> <input type="checkbox"/> Significant experience in developing such regulations from states with history of petroleum development facilitates rule development <input type="checkbox"/> Reduced risk of environmental exposure to pollutants from waste streams <input type="checkbox"/> Requirements that call for off-site disposal can increase truck traffic; on-site disposal may increase size of well site 	<input type="checkbox"/> Proposed requirement for disposal of drill cuttings in approved solid waste disposal facility in New York proposed SGEIS ²³
	Regulation of exploration and production waste through RCRA / CERCLA systems	<ul style="list-style-type: none"> <input type="checkbox"/> Requires federal legislative action <input type="checkbox"/> Would increase federal authority to regulate disposal of wastes (increased state authority under delegated programs) <input type="checkbox"/> Would represent significant change in federal policy <input type="checkbox"/> Increased costs of enforcement 	<input type="checkbox"/> NRDC proposed rulemaking proposal to amend Subtitle C of RCRA ²⁴
Handling of wastes with high NORM content	Regulation of NORM disposal if materials exhibit elevated levels of radioactivity or have high concentrations of NORM	<ul style="list-style-type: none"> <input type="checkbox"/> Potentially reduces risks associated with exposure to sources of radioactivity <input type="checkbox"/> Likely applies to relatively small portion of NGE wastes <input type="checkbox"/> Potentially expensive compliance <input type="checkbox"/> Disposal of materials with high levels of NORM could take already-scarce space at approved disposal facilities 	<input type="checkbox"/> New York state requirements for handling of NORM found in New York proposed SGEIS. ²⁵

Liability Issues

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Avoidance of environmental liability through bankruptcy / dissolution of company	Prohibit discharge of environmental liability in bankruptcy / prohibit dissolution of company while it holds environmental liabilities	<ul style="list-style-type: none"> <input type="checkbox"/> Provides additional enforcement strength for payment of environmental costs <input type="checkbox"/> Requires federal legislative action (bankruptcy code) or state legislative action (corporate dissolution) <input type="checkbox"/> May not provide any additional benefit if company does not have financial ability to fund cleanup efforts 	<input type="checkbox"/> Research did not reveal any such prohibitions currently in place

Financing Government Responses to NGE Issues

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Generating revenue to finance governmental functions necessitated by NGE activity	<i>Ad valorem</i> (value-based) severance tax or fee on NG production	<ul style="list-style-type: none"> <input type="checkbox"/> Provides revenue source to fund needed government services, particularly where need for services derives from NGE activities <input type="checkbox"/> Severance tax may allow for internalization of externalities and help set extraction rates closer to societal “optimal” rates <input type="checkbox"/> Allows flexibility to NG developers since cost of tax increases with increased NG prices, but decreases with decreased prices <input type="checkbox"/> Flexibility of tax results in flexibility of revenue generated, which may provide “windfall” to government if prices are high, but may result in deficiencies if prices are low 	<ul style="list-style-type: none"> <input type="checkbox"/> Texas severance tax (value-based severance tax)²⁶ <input type="checkbox"/> Pennsylvania Unconventional Natural Gas Well Fee (limited-flex per-well fee adjusted on schedule based on annual natural gas average price; not a “severance” tax in that it is not dependent on volume of NG produced).²⁷
	Fixed (per-unit) severance tax on NG	<ul style="list-style-type: none"> <input type="checkbox"/> Provides revenue source to fund needed government services, particularly where need for services derives from NGE activities <input type="checkbox"/> Severance tax may allow for internalization of externalities and help set extraction rates closer to societal “optimal” rates <input type="checkbox"/> May increase revenue stability for government since tax is volume-based, and historically, production volumes have been less volatile than prices <input type="checkbox"/> Reduced flexibility to NG developers since cost of tax remains constant even if NG prices fall 	<ul style="list-style-type: none"> <input type="checkbox"/> Louisiana severance tax²⁸
	Establish trust fund to save collections and provide long-term revenue source	<ul style="list-style-type: none"> <input type="checkbox"/> Provides revenue source that may be sustained after depletion of exhaustible resource <input type="checkbox"/> Revenues generated from fund can be used to diversify local/regional economy to reduce negative effects of decrease in NGE activity <input type="checkbox"/> Fund requires careful management and commitment of all stakeholders to long-term vision for fund <input type="checkbox"/> Fund may be target of “raiding” in times of reduced budgets 	<ul style="list-style-type: none"> <input type="checkbox"/> Iron Range Trust / Iron Range Resources and Rehabilitation Board²⁹
	Creation of mitigation fund by voluntary payments from resource developers	<ul style="list-style-type: none"> <input type="checkbox"/> Creates highly-flexible revenue source that can be used to address broad range of community needs <input type="checkbox"/> Voluntary nature of payments and participation in decisions regarding fund usage engages resource developers in community matters <input type="checkbox"/> Developers may be unwilling to make voluntary payments if already required to pay number of other taxes <input type="checkbox"/> If large number of developers are involved, development of consensus and “enforcement” of contributions may become difficult <input type="checkbox"/> Small independent developers may be unwilling or unable to contribute at same level as larger developers. 	<ul style="list-style-type: none"> <input type="checkbox"/> IPP mitigation fund for community of Delta, Utah³⁰
Allocation of collected revenues to jurisdictions bearing costs of NGE activity	Revenue-sharing requirement for collecting government unit to allocate revenues to other jurisdictions in proportion to measure of NGE impacts	<ul style="list-style-type: none"> <input type="checkbox"/> Links revenues generated by NGE activities to costs incurred as result of those activities, and links benefits and burdens of development <input type="checkbox"/> Implementation of revenue sharing among jurisdictions adds complexity to administration of revenue mechanism <input type="checkbox"/> Crafting “proportionate” allocation method complex and difficult test requiring balancing number of interests 	<ul style="list-style-type: none"> <input type="checkbox"/> Pennsylvania Unconventional Natural Gas Well Fee allocation system; portions of funding allocated based on number of unconventional wells, population, miles of state highway and other proportional measures³¹

Planning for Community Needs

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Need to engage community stakeholders to plan responses to increased needs for services and infrastructure in community	Education efforts to familiarize local leaders and stakeholders with likely “boomtown” impacts and examples of how impacts can be successfully managed.	<ul style="list-style-type: none"> <input type="checkbox"/> Allows leaders to learn from experiences of other communities, facilitating their ability to predict potential challenges and plan responses <input type="checkbox"/> Question of who to include in training and how to select training materials & experiences <input type="checkbox"/> May unintentionally exacerbate “anticipatory” negative impacts of development by learning of challenges faced in other communities 	<ul style="list-style-type: none"> <input type="checkbox"/> Delta, Utah leaders’ “boomtown” tour of communities that had faced similar development issues (construction of large power plant).³²
	Create environment for community engagement to receive stakeholder input regarding identified needs and concerns via surveys, focus groups, and facilitated public forums	<ul style="list-style-type: none"> <input type="checkbox"/> Public deliberation method allows stakeholders to constructively reshape the problem and to identify themes common among multiple groups <input type="checkbox"/> Deliberation process itself may increase community engagement by allowing diverse stakeholder to “let their voice be heard” <input type="checkbox"/> Success of efforts require buy-in from broad cross-section of community and from NG developers <input type="checkbox"/> Process must be diligently moderated to avoid assertion of control by any one group or devolution of discussion process into “venting” 	<ul style="list-style-type: none"> <input type="checkbox"/> Kettering Model³³

Housing

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Availability of housing for workforce	Community-built and operated housing facilities (may be mix of permanent, semi-permanent, RV parks, manufactured / modular housing)	<ul style="list-style-type: none"> <input type="checkbox"/> Providing locally-available housing encourages works to spend locally, increasing ability of community to capture benefits of NGE activities <input type="checkbox"/> Public-private partnerships to develop housing could simultaneously address multiple housing needs (family housing, community facilities, “dry” housing to address alcohol and substance abuse issues) <input type="checkbox"/> Housing that allows workers’ families to join them can avoid numerous other negative impacts (reduction in crime) <input type="checkbox"/> Community must have human and financial capital to build, operate, supervise and maintain facilities <input type="checkbox"/> Question of sustainability if housing cannot be successfully reused or repurposed post-boom 	<ul style="list-style-type: none"> <input type="checkbox"/> Sublette County, Wyoming oilfield housing and regulations³⁴
	Developer-led construction of temporary and semi-permanent housing that is removed or turned over to local ownership upon project completion	<ul style="list-style-type: none"> <input type="checkbox"/> Provision of housing by developers links benefits and burdens of NGE activities <input type="checkbox"/> Flexibility in type of housing (modular, manufactured, and semi-permanent) can avoid overwhelming market in start of “boom” cycle and removing housing can stabilize property values after it ends <input type="checkbox"/> Housing that allows workers’ families to join them can avoid numerous other negative impacts (reduction in crime) <input type="checkbox"/> May require adaptation or modification of local land use restrictions <input type="checkbox"/> Requires commitment by developers to maintain properties and honor obligations for closure when units are no longer needed <input type="checkbox"/> Question of sustainability if housing cannot be successfully reused or repurposed post-boom 	<ul style="list-style-type: none"> <input type="checkbox"/> IPP housing program in Delta, Utah³⁵
	Educate local construction companies, realtors, lenders, and permitting agencies about likely housing needs	<ul style="list-style-type: none"> <input type="checkbox"/> Can expedite development of housing stock by building both human capital and overall capacity of local housing sector <input type="checkbox"/> Lenders and permitting agencies may also need information regarding projected needs to position their institutions for rapid response <input type="checkbox"/> Depends upon availability of land, willing and able developers, and availability of workforce (which may be strained due to NGE needs) 	<ul style="list-style-type: none"> <input type="checkbox"/> Extension of community engagement models, ex. Kettering model
	Increase capacity of local planning/permitting departments by “lending” planning staff from other jurisdictions with excess capacity	<ul style="list-style-type: none"> <input type="checkbox"/> Decreases time needed to secure permits to build/develop housing <input type="checkbox"/> Makes use of existing human capital that may be underutilized; can extend benefits of NGE activities to employees involved <input type="checkbox"/> May require authorizing legislation or cooperative agreements to be negotiated among participating communities <input type="checkbox"/> Moving staff to community may worsen problem it is meant to solve (may be alleviated or eliminated by allowing participants to telecommute) 	<ul style="list-style-type: none"> <input type="checkbox"/> Concept of development capacity-building outlined in “Marcellus Natural Gas Developments Effect on Housing in Pennsylvania” report³⁶
Accessibility of housing for fixed or low-income residents	Use of voucher or subsidy programs for low- or fixed-income residents	<ul style="list-style-type: none"> <input type="checkbox"/> Provides means of combating inflation in housing prices targeted at residents in most need of assistance <input type="checkbox"/> Presumes availability of suitable housing stock; if not initiated early enough in “boom” cycle, may not have access to sufficient quality and quantity of stock <input type="checkbox"/> Defining and auditing qualification criteria may be difficult <input type="checkbox"/> Section 8 (housing choice vouchers) are limited to lowest income consumers; oilfield workers will likely not qualify 	<ul style="list-style-type: none"> <input type="checkbox"/> Federal program: Department of Housing and Urban Development Section 8 vouchers program³⁷

Sociological Impacts

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Increased crime / fear of crime	Increase level of connection between workers and community through directed community engagement programs	<ul style="list-style-type: none"> <input type="checkbox"/> Research indicates increasing police strength alone may not significantly impact crime rates, may be expensive or take too long for smaller communities <input type="checkbox"/> Addresses number of other "boom" stressors deriving from isolation factors <input type="checkbox"/> May have limited effectiveness where workers are engaged in long, irregular work periods in isolated areas or where workers are commuters rather than residents 	<ul style="list-style-type: none"> <input type="checkbox"/> "Civic community" concept in Lee and Thomas (2010), social factors facilitating crime in Carrington, McIntosh and Scott (2010), and community development initiatives in Cheshire (2010)³⁸
Substance abuse issues	Intensive, on-site services such as counseling and harm reduction services, provision of "dry" camps and/or family housing	<ul style="list-style-type: none"> <input type="checkbox"/> Irregular work schedules and geographic isolation that can contribute to substance abuse issues may also frustrate traditional support program delivery; on-site delivery of programs can counteract these elements <input type="checkbox"/> Availability of dry camps or family housing could reduce negative influences / increase positive influences for workers <input type="checkbox"/> Requires development of partnership with NG developers to provide on-site facilities 	<ul style="list-style-type: none"> <input type="checkbox"/> Intervention programs outlined in Goldenberg, et al (2010)³⁹
Increased incidence of sexually transmitted diseases, esp. among young NGE workers	Public-private partnerships with NG developers and local health authorities; place-based awareness, testing, and prophylactic distribution programs	<ul style="list-style-type: none"> <input type="checkbox"/> Work conditions of many NG industry employees makes access to testing and preventative services difficult; culture may stigmatize seeking of assistance <input type="checkbox"/> Public and private partnerships may enable more specific and effective targeting of programs <input type="checkbox"/> Delivery of programs on work sites may encourage use of services <input type="checkbox"/> Requires willingness of all parties to participate and culture supporting assistance <input type="checkbox"/> Local groups may object to involvement with this aspect of public health 	<ul style="list-style-type: none"> <input type="checkbox"/> Program outlined in work of Goldenberg, et al.⁴⁰
Individual / family stressors manifested in individual mental health issues, increased rates of divorce / domestic violence	Coordinated community programs providing group support/therapy for domestic violence issues	<ul style="list-style-type: none"> <input type="checkbox"/> Group support/therapy programs shown to reduce incidence of family stress issues such as divorce, violence <input type="checkbox"/> Tailoring of programs to specific needs (age, ethnic/cultural groups, chemical dependency) may be needed to increase efficacy of program <input type="checkbox"/> Maximum effectiveness may also require legal consequences for offenders who do not complete program <input type="checkbox"/> Research shows impact of programs may be small compared to cost 	<ul style="list-style-type: none"> <input type="checkbox"/> Duluth Domestic Abuse Intervention Project model⁴¹
Increased youth behavioral problems / crime	Community engagement programs to create youth-supportive local environments	<ul style="list-style-type: none"> <input type="checkbox"/> Community-based approach can focus on preventive measures to avoid unhealthy behaviors in youth <input type="checkbox"/> Programs can also increase engagement among long-term residents and new residents if both are involved in program <input type="checkbox"/> Question of who will be involved and what roles they will play <input type="checkbox"/> May take years for effects of program to become apparent 	<ul style="list-style-type: none"> <input type="checkbox"/> Communities that Care program⁴²
Increased isolation / disengagement / community cohesion and identity concerns	"Welcome wagon" to facilitate integration of new and long-term residents and facilitate interactions with current residents; community social activities creating opportunities for development of new acquaintances	<ul style="list-style-type: none"> <input type="checkbox"/> Lack of community connectedness and decreased density of acquaintance often cited as factors contributing to decreased quality of life in boomtown communities <input type="checkbox"/> Can affect perceptions of both long-term and new residents relative to each other <input type="checkbox"/> May increase community ties and encourage new residents to become long-term residents <input type="checkbox"/> Requires number of local "champions" to engage long-term residents who may be reluctant to participate <input type="checkbox"/> Irregular work schedules and geographic isolation may limit ability of NGE workers to participate 	<ul style="list-style-type: none"> <input type="checkbox"/> "Community Cohesion" policy in UK⁴³ <input type="checkbox"/> Mining community development programs in Australia⁴⁴

Education

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Increased need for schooling for families that move to the area	Use of temporary facilities to accommodate increases in student enrollment; "shift" classes	<ul style="list-style-type: none"> <input type="checkbox"/> Temporary structures or repurposed facilities (ex. converted retail or commercial space) may be able to provide space for additional classes <input type="checkbox"/> Requires additional qualified teachers, which may be difficult if housing is not available and/or inflationary pressures make cost of living high <input type="checkbox"/> Separation of classes from main campuses may make administration, integration of student populations difficult <input type="checkbox"/> If additional classroom space is not available, students may attend some classes in "shifts" <input type="checkbox"/> Research suggests students in such environments may not perform at same level of students in more traditional learning environments 	<ul style="list-style-type: none"> <input type="checkbox"/> Educational impacts discussed in Jacquet (2009)⁴⁵
	Facilitate homeschooling / alternative schooling arrangements	<ul style="list-style-type: none"> <input type="checkbox"/> Homeschooling or other arrangements (such as combined-grade / "one room" schools) may make educational opportunities available where traditional modes would be difficult to implement, esp. in isolated areas and family housing developments <input type="checkbox"/> May reduce strain on existing school systems <input type="checkbox"/> Can address number of impacts cited as influences in "boomtown" schools <input type="checkbox"/> May be difficult to implement with highly mobile population <input type="checkbox"/> May increase community isolation factors 	<ul style="list-style-type: none"> <input type="checkbox"/> National Home Education Research Institute materials⁴⁶

Workforce Availability

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Insufficient local skilled labor to fill available NGE jobs	Accelerated training programs	<ul style="list-style-type: none"> <input type="checkbox"/> Can improve local employment and local capture of economic benefits <input type="checkbox"/> Most effective if conducted in partnership with NG developers <input type="checkbox"/> Only effective if nearby population is large enough to meet industry needs <input type="checkbox"/> Requires available education facilities, staff, and curricula 	<ul style="list-style-type: none"> <input type="checkbox"/> Odessa College oilfield training program⁴⁷ <input type="checkbox"/> High Plains Technology Center wind energy training program⁴⁸

Transportation Infrastructure

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Paying for repairs / improvements due to increased traffic from NGE activities	Posting and enforcement of vehicle weight limits	<ul style="list-style-type: none"> <input type="checkbox"/> Established weight limits for defined roads; vehicles over weight limit must have permit (with fee) or must post bond for potential road damage <input type="checkbox"/> Requires police or transportation enforcement of limits and permits <input type="checkbox"/> Reducing amount of weight that can be carried by single vehicle may increase overall volume of traffic 	<ul style="list-style-type: none"> <input type="checkbox"/> Pennsylvania municipality and township regulations (certain jurisdictions only)⁴⁹
	Well permit fees	<ul style="list-style-type: none"> <input type="checkbox"/> Links public costs of NGE impacts to revenue and specifically allocates portion of fee to road repair / improvement <input type="checkbox"/> May not be proportionate in effect (wells using less truck-trips charged same amount as wells using more truck-trips) 	<ul style="list-style-type: none"> <input type="checkbox"/> Pennsylvania Act 13 allocation of unconventional natural gas wells to transportation funds (based on highway mileage)⁵⁰
	Road maintenance agreements	<ul style="list-style-type: none"> <input type="checkbox"/> Public-private agreements for payment of funds (sometimes called "in lieu of" funds) to government units for road maintenance needs caused by NGE activity <input type="checkbox"/> May be easier to implement if small number of NG developers operating in area; more difficult if large number of operators in area 	<ul style="list-style-type: none"> <input type="checkbox"/> Ohio Road Use Maintenance Agreement provisions under Senate Bill 325⁵¹

Landowner Issues

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Visual impacts and light pollution / aesthetic concerns	Tree belts / fencing or other visual barriers around sites, directional lighting requirements, operational hour restrictions	<ul style="list-style-type: none"> <input type="checkbox"/> Visual impacts often cited as source of aesthetic concerns and nuisance issues; addresses this issue, at least in part <input type="checkbox"/> Restriction of operational hours may cause production delays or problems for NG developers 	<ul style="list-style-type: none"> <input type="checkbox"/> City of Arlington lighting restrictions, requirement for site maintenance to avoid “unsightly” condition⁵² <input type="checkbox"/> City of Fort Worth aesthetic restrictions⁵³
Noise impacts	Specification of maximum noise levels, requirement for noise mitigation measures such as mufflers, sound blankets, and sound walls, operational hour restrictions	<ul style="list-style-type: none"> <input type="checkbox"/> Auditory impacts also often cited as source of aesthetic concerns and nuisance issues; also form basis of some health concerns <input type="checkbox"/> Restriction of operational hours may cause production delays or problems for NG developers 	<ul style="list-style-type: none"> <input type="checkbox"/> City of Arlington noise restrictions (decibel limits for operations, measurement procedures, and sound mitigation technologies specified)⁵⁴ <input type="checkbox"/> City of Fort Worth noise restrictions (similar)⁵⁵
Property value impacts	Prohibit NGE activities within residential areas	<ul style="list-style-type: none"> <input type="checkbox"/> Residential areas pose highest concentration of potential property value impacts as well as other impacts (visual, auditory, traffic, etc.) <input type="checkbox"/> Ban may also reduce environmental concerns of residents <input type="checkbox"/> Blocks development of some resource deposits <input type="checkbox"/> Potential challenges from mineral owners in residential areas <input type="checkbox"/> Potential jurisdictional/authority issues 	<input type="checkbox"/> City of South Fayette, Pennsylvania Ordinance No. 5 of 2012 (currently under judicial review) ⁵⁶
	Establish setback requirements for NG wells relative to sensitive property items (homes, water wells, etc).	<ul style="list-style-type: none"> <input type="checkbox"/> Setbacks may reduce impacts to most sensitive receptors from NGE activities <input type="checkbox"/> Larger setback distances may functionally ban NG wells in areas with high density of setback points 	<input type="checkbox"/> Colorado Oil and Gas Conservation Commission setback rules (proposed). ⁵⁷
	Mitigation of specific real or perceived impacts by NG developers provision of alternative sources (ex.: groundwater well impacts avoided by municipal water supply extension)	<ul style="list-style-type: none"> <input type="checkbox"/> In some cases, one specific factor (ex. real or perceived groundwater impacts) may have significant impact to property values; addressing specific factor may have important marginal impacts on property values <input type="checkbox"/> Determining specific factors may require intensive analysis of factors unique to area <input type="checkbox"/> NG developers may be unwilling to participate in voluntary mitigation program, esp. if recipients of mitigation benefits already receiving mineral payments 	<input type="checkbox"/> Property value impacts outlined in Muehlenbachs, Spiller, and Timmins (2012) ⁵⁸
Benefit/burden sharing between surface and mineral owners	Require compensation to surface owners and tenants for NG exploration and extraction activities impacting surface (surface damage payments)	<ul style="list-style-type: none"> <input type="checkbox"/> Provides compensation to surface estate, which has to bear burden of NGE activities without other economic benefits. <input type="checkbox"/> Reduces litigation and facilitates NG development by reducing need for surface owners to sue developers for damages to receive compensation. <input type="checkbox"/> May represent significant change to property law. <input type="checkbox"/> Requires state legislative action 	<input type="checkbox"/> North Dakota statutes governing oil and gas production damage compensation and seismic exploration damages ⁵⁹
	Allow surface owner to claim “abandoned” mineral interests, reuniting surface and mineral estates	<ul style="list-style-type: none"> <input type="checkbox"/> Creates opportunity to unify surface and mineral estates, thus aligning interests bearing burdens and benefits of NGE <input type="checkbox"/> Requires vigilance on part of mineral owners to retain interest <input type="checkbox"/> Requires state legislative action 	<input type="checkbox"/> North Dakota statutes governing termination of mineral interest ⁶⁰
	Prohibit severance of mineral estate if not already severed	<ul style="list-style-type: none"> <input type="checkbox"/> Avoids additional fragmentation of mineral estates, which can provide benefits to surface owners and NG developers <input type="checkbox"/> Reduces opportunities for economic exchange of mineral resources <input type="checkbox"/> Requires state legislative action 	<input type="checkbox"/> Oklahoma Airspace Severance Restriction Act (analogous provision for wind rights) ⁶¹

Landowner Negotiation of Resource Development Agreements

Issue	Policy Alternatives	Potential Consequences	Examples (if available)
Asymmetries of information / negotiating power in resource lease agreements	Educational programs providing information on lease negotiation to landowners	<input type="checkbox"/> Increases landowner awareness of issues to be examined in evaluating resource leases <input type="checkbox"/> Provides landowners with improved ability to negotiate balanced lease agreements <input type="checkbox"/> Improved information may facilitate accrual of economic benefits to local residents <input type="checkbox"/> Requires funding and acquisition of knowledgeable staff to develop, implement, update, and present materials	<input type="checkbox"/> Penn State Extension Natural Gas Program ⁶²
	Provide information “clearinghouse” and landlord forum with lease examples and updated information on compensation values	<input type="checkbox"/> Increases landowner access to information on sample lease provisions to protect rights and “going rates” on compensation items such as royalties and damage payments <input type="checkbox"/> Provides landowners with improved ability to negotiate balanced lease agreements <input type="checkbox"/> Improved information may facilitate accrual of economic benefits to local residents <input type="checkbox"/> Requires funding to acquire information, deploy information sharing tools, and to curate information / forums <input type="checkbox"/> Information may be difficult to obtain as NG developers may be reluctant to share information <input type="checkbox"/> Information obtained by landowner surveys may require verification	<input type="checkbox"/> Privately-organized and curated Natural Gas Forums ⁶³

Notes

¹ <http://www.state.nj.us/governor/news/news/552011/approved/20110825c.html>.

² <http://www.governor.ny.gov/archive/paterson/executiveorders/EO41.html>.

³ <http://www.alternet.org/fracking/after-federal-and-state-governments-fail-regulate-fracking-communities-fight-back>.

⁴ <http://www.breakinglawsuitnews.com/morgantown-wv-fracking-ban-overtuned/>.

⁵ 165 OKLA. ADMIN. CODE Ch. 10, Subch. 1, Part 5 (2011).

⁶ 2 COLO. CODE REGS. §§ 402-16.5 and 402-16.8 (2012).

⁷ http://www.shalegas.energy.gov/resources/HF2_e1.pdf.

⁸ <http://www.michigandnr.com/PUBLICATIONS/PDFS/ifr/ifrilibra/Research/reports/2089/RR2089.pdf>.

⁹ <http://www.circleofblue.org/waternews/2013/world/amid-roaring-demand-a-u-s-city-plans-to-triple-water-rates-for-oil-and-gas-customers/>.

¹⁰ New York SGEIS (proposed) section 7.1.7.4. (2011).

¹¹ 165 OKLA. ADMIN. CODE §10-7-6 (2012).

¹² 16 TEXAS ADMIN CODE §3.13.

¹³ H.R. 1084, S. 587.

¹⁴ Colorado Oil & Gas Conservation Commission Rule 609 (enacted January 7, 2013), at http://cogcc.state.co.us/RR_HF2012/Groundwater/FinalRules/FinalRule609-01092013.pdf.

¹⁵ 58 PENN. CONS. STAT. §3218 (2012).

¹⁶ 58 PENN. CONS. STAT. §3222.1 (2012).

¹⁷ 76 FED. REG. 66286-66304 (October 26, 2011).

¹⁸ New York Bill S6893 (2012).

¹⁹ New Jersey Assembly Bill 575 (2012).

²⁰ 40 C.F.R. Part 60, Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution) (2013).

²¹ 40 C.F.R. Part 60, Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines) (2013).

²² 30 TEX. ADMIN. CODE Ch. 115, Subch. B, Div. 1 (2012).

²³ New York SGEIS (proposed) section 7.1.3.2. (2011).

²⁴ http://docs.nrdc.org/energy/files/ene_10091301a.pdf.

²⁵ New York SGEIS (proposed) section 7.7.2. (2011).

- ²⁶ TEX. TAX CODE §§201.001 – 204.010 (2012).
- ²⁷ 58 PENN. CONS. STAT. §2302 (2012).
- ²⁸ LA. ADMIN. CODE §§ 61:1.2901 – 61:1.2903 (2012).
- ²⁹ <http://mn.gov/irrrb/>.
- ³⁰ Ralph B. Brown et al, *Local Flexibility in Spending Mitigation Monies: A Case Study of Successful Social Impact Mitigation of the Intermountain Power Project in Delta, Utah*, 21:3 IMPACT ASSESSMENT AND PROJECT APPRAISAL 205-213 (2012).
- ³¹ 58 PENN. CONS. STAT. §2314 (2012).
- ³² Ralph B. Brown et al, *Local Flexibility in Spending Mitigation Monies: A Case Study of Successful Social Impact Mitigation of the Intermountain Power Project in Delta, Utah*, 21:3 IMPACT ASSESSMENT AND PROJECT APPRAISAL 205-213 (2012).
- ³³ www.kettering.org.
- ³⁴ A. Best, *Bad Gas or Natural Gas*, 75:9 PLANNING 30-34 (2009).
- ³⁵ Ralph B. Brown et al, *Local Flexibility in Spending Mitigation Monies: A Case Study of Successful Social Impact Mitigation of the Intermountain Power Project in Delta, Utah*, 21:3 IMPACT ASSESSMENT AND PROJECT APPRAISAL 205-213 (2012).
- ³⁶ Jonathan Williamson and Bonita Kolb, MARCELLUS NATURAL GAS DEVELOPMENT'S EFFECT ON HOUSING IN PENNSYLVANIA, Center for the Study of Community and the Economy, 2011, available at <http://www.marcellus.psu.edu/resources/PDFs/housingreport.pdf>.
- ³⁷ http://portal.hud.gov/hudportal/HUD?src=/topics/housing_choice_voucher_program_section_8.
- ³⁸ M. R. Lee and S. A. Thomas, *Civic Community, Population Change, and Violent Crime in Rural Communities*, 47 JOURNAL OF RESEARCH IN CRIME AND DELINQUENCY 118-147 (online at <http://irc.sagepub.com/content/47/1/118>) (2009); K. Carrington, A. McIntosh and J. Scott, *Globalization, Frontier Masculinities and Violence: Booze, Blokes and Brawls*, 50 BRITISH JOURNAL OF CRIMINOLOGY 393-413 (2010); L. Cheshire, *A Corporate Responsibility: The Constitution of Fly-in, Fly-out Mining Companies as Governance Partners in Remote, Mine-affected Localities*, 26:1 JOURNAL OF RURAL STUDIES 12-20 (2010).
- ³⁹ S.M. Goldenberg, J.A. Shoveller, M. Koehoorn and A. Ostry, *And They Call This Progress? Consequences for Young People of Living and Working in Resource-Extraction Communities*, 20:2 CRITICAL PUBLIC HEALTH 157-168 (2010).
- ⁴⁰ S. Goldenberg, J. Shoveller, A. Ostry, and M. Koehoorn, *Sexually transmitted infection (STI) testing among young oil/gas workers: the need for innovative, place-based approaches to STI control*. 99:4 CANADIAN J. OF PUBLIC HEALTH 350-354 (2008); S. Goldenberg, J. Shoveller, A. Ostry, and M. Koehoorn, *Youth sexual behavior in a 'Boomtown': implications for the control of sexually transmitted infections*. 84 Sexually Transmitted Infections 220-223 (2008).
- ⁴¹ The Duluth model is discussed at <http://www.theduluthmodel.org/training/index.html>. Research regarding the impacts of this and similar intervention programs can be found in Julia Babcock and Ramalina Steiner, *The Relationship Between Treatment, Incarceration, and Recidivism of Battering: A Program Evaluation of Seattle's Coordinated Community Response to Domestic Violence*, 13:1 JOURNAL OF FAMILY PSYCHOLOGY 46-59 (1999), and J. Babcock, C. Green, and C. Robie, *Does Batterer's Treatment Work? A Meta-analytic Review of Domestic Violence Treatment*, 23 CLINICAL PSYCHOLOGY REVIEW 1023-1053 (2004).
- ⁴² See Substance Abuse and Mental Health Services Administration, Center for Substance Abuse Prevention, <http://www.samhsa.gov/about/csap.aspx>
- ⁴³ D. Robinson, *The Search for Community Cohesion: Key Themes and Dominant Concepts of the Public Policy Agenda*, 42:8 URBAN STUDIES 1411-1427(2005).
- ⁴⁴ L. Cheshire, *A Corporate Responsibility: The Constitution of Fly-in, Fly-out Mining Companies as Governance Partners in Remote, Mine-affected Localities*, 26:1 JOURNAL OF RURAL STUDIES 12-20 (2010).
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- ⁴⁸ <http://www.hptc.net/bis/energytraining/windtechtraining.asp>.
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- ⁵³ City of Fort Worth (Texas) Code of Ordinances, Chapter 15, § 15-36(C)(10).
- ⁵⁴ City of Arlington (Texas) Code, Gas Drilling and Production, § 7.01(G)(2012).
- ⁵⁵ City of Fort Worth (Texas) Code of Ordinances, Chapter 15, § 15-42(B)(2)(2012).
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- ⁵⁷ http://cogcc.state.co.us/RR_HF2012/Setbacks/COGCC_APPROVES_SWEEPING_NEW_SETBACK_RULES.pdf, rules docket posted at http://cogcc.state.co.us/RR_HF2012/setbacks/setbacks.htm .
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- ⁵⁹ N.D. CENT. CODE Ch. 38-11.1 and 38-11.2 (2012).
- ⁶⁰ N.D. CENT. CODE Ch. 38-18.1 (2012).
- ⁶¹ 60 OKLA. STAT. § 820.1 (2012).
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