

# Gas Drilling in the Finger Lakes Region: How Will it Affect Us?

**Sandy & Bill Podulka**  
**Marcellus Accountability Project–Tompkins**

As most people have heard by now, the powerful and poorly regulated gas-drilling industry has placed the natural gas in the shale under New York State squarely in its crosshairs. The tens of thousands of unconventional gas wells planned for the Southern Tier will dramatically transform our landscape—bringing the greatest change since the original forests were cut. Gas drilling will touch every aspect of our lives—from our food, water, health, and safety, to our property values, taxes, and local economy, and to the relationships between neighbors. If we can better understand the risks involved, we can work to help mitigate or perhaps prevent the damage and to better protect ourselves and our communities. Although this article focuses on the Marcellus shale, most of the information also applies to other shale layers, such as the Utica.

## **Drilling in the Marcellus Shale:**

The Finger Lakes Region sits above the Marcellus shale, a rock layer that underlies Pennsylvania, West Virginia, Eastern Ohio, and the Southern Tier and Catskill regions of New York<sup>1</sup>; it lies 1,500 to 3,000 feet deep in Tompkins County.<sup>2</sup> It is thought to contain the third largest natural gas deposit in the world—the biggest in the US—worth around a trillion dollars.<sup>3</sup> Because gas in the Marcellus shale is dispersed throughout the rock, it is costly and difficult to extract. But new procedures have made its extraction profitable, so the gas industry is poised to begin intensive drilling in our area. Because of the vast infrastructure involved (pipelines, compressor stations, storage facilities for chemicals, and so on), to be most profitable, companies drill thousands of wells in a region.

In the Marcellus shale of NY, the maximum allowed density of well pads (the cleared surface areas where wells are drilled) is 1 per 40 acres (16 per square mile); at this density, only 1 well may be drilled per pad. Companies, however, are likely to space pads more widely, grouping 6 to 8 or more wells on the same pad<sup>4</sup> and making the pads larger (3 to 5 acres or more).<sup>5</sup> These cleared industrial sites host drill rigs, tanker trucks, access roads, dozens of huge holding tanks for water and chemicals, buildings for workers, and often, open pits of hazardous waste. At times they may contain pumps and/or compressors.

Note that these spacing regulations could result in more or fewer than 16 Marcellus shale wells per square mile (640 acres), depending on the size of the spacing unit (see “Compulsory Integration” below) and the number of wells per pad, which is not restricted. The regulations also allow vertical “infill wells” to be drilled between existing well pads at a later date, “with justification.” (This applies to any well pads at a spacing greater than 40 acres).<sup>6</sup> Furthermore, well pad densities apply only to a specific rock layer, so networks of wells in different layers could concurrently be drilled in the same area, each at their allowable spacings, resulting in a much greater total well density for a region.

The recent prediction of there being a 50% chance of 489 trillion cubic feet of gas being produced over 50 years from the entire Marcellus Shale<sup>7</sup> requires a well pad every square mile with 8 wells per pad over 70% of the Marcellus shale formation. This scenario results in 2,600 wells for Tompkins County, alone.<sup>8</sup> Administrators in Tompkins and Broome Counties, however, are expecting 4,000 wells in each county.<sup>9</sup>

The Millennium Pipeline, which runs from Corning to Rockland County, will transport the gas to New York City and beyond. Eventually, every individual gas well will connect to it through smaller pipelines, forming a massive network snaking throughout our region. Because the land over the pipelines must be kept free of trees, and will be seeded and controlled for “noxious weeds,” widespread fragmentation of forests will result. This is concerning and may reverse efforts of local environmental groups, such as the Finger Lakes Land Trust, to preserve large, unbroken tracts and corridors of undeveloped land that provide high-quality wildlife habitat.

### **DEC Regulation of Gas Drilling through the SGEIS:**

Gas companies have already begun to extract gas from shale in other states, such as Pennsylvania, Wyoming, Colorado, and Texas, but in New York are choosing to wait, for reasons explained below. A common misconception is that there is currently a moratorium on shale gas drilling in the state.

Gas drilling in New York falls under the State Environmental Quality Review Act (SEQRA),<sup>10,11</sup> which requires that a company carry out an Environmental Impact Statement before proceeding. Most past activities have been regulated by an umbrella-like Generic Environmental Impact Statement funded by taxpayers and written by the Department of Environmental Conservation (DEC) in 1992.<sup>12</sup> But the extraction process to be used on the Marcellus and Utica shale (high-volume hydraulic fracturing, see below) poses dramatically greater environmental risks than conventional drilling, and was not addressed in 1992. Thus the DEC, at further taxpayer expense, is currently producing a supplement to the 1992 regulations, called the Supplemental Generic Environmental Impact Statement (SGEIS). If done properly, the SGEIS would satisfy the SEQRA requirements and thus streamline permitting. Gas companies could then proceed without spending their own money on a site-specific Environmental Impact Statement for each drilling site. The DEC produced an 800-page draft SGEIS in September 2009, and the public comment period ended December 31, 2009.

On April 23, 2010, the DEC announced that the SGEIS will not give blanket coverage to wells drilled in the Catskills watershed that provides New York City's drinking water or in the Skaneateles Lake watershed that provides Syracuse's drinking water.<sup>13,14</sup> Both of these watersheds have "filtration avoidance determination" (FAD) status, which means that the water may be used directly for drinking without further treatment. Instead, drilling in these areas will require a "case-by-case environmental review process" to establish whether appropriate mitigation measures exist. It may now be much less likely that drilling will occur in these two watersheds, and more likely that it will occur elsewhere, as some of the more powerful opponents to drilling have been somewhat placated. This decision, while welcomed by many concerned people in New York City and Syracuse as a step in the right direction, has nevertheless caused outrage from people in the rest of the state who also are concerned about their drinking water.

The DEC received over 14,000<sup>13</sup> public comments on the draft SGEIS.<sup>15</sup> Many people expressed serious concerns, pointing out that it contains (1) no evaluation of the cumulative impacts of multiple wells in an area, (2) no evaluation of the health and environmental effects of pipelines and compressor stations and thus does not satisfy SEQRA law,<sup>16</sup> (3) no evidence showing that extracting gas from shale in NY would provide a net benefit to the average resident of the state, (4) no scientific data or analyses of the health effects of shale gas extraction in NY, (5) no serious consideration of either greener technologies or alternatives to gas extraction, (6) no requirement that all the chemicals used in fracking any given well be disclosed to the public, (7) very few specific, enforceable regulations on the gas industry, instead making suggestions and leaving much up to the judgment of DEC staff approving permits, (8) no evaluation of the social and economic effects of gas drilling on communities, (9) no evaluation of the effects of air pollution from shale gas extraction on public health or on air quality, (10) no information on whether natural gas is actually cleaner than coal or oil when the entire life cycle of the fossil fuel (from extraction to burning and disposal) is considered, and (11) no evaluation of the DEC's ability to enforce the state regulations with its staff of 17 field inspectors.<sup>17</sup>

The public now awaits the next version of the SGEIS, which the DEC has said will be out by the end of 2010. Will the DEC simply tweak the current document without further study, thus opening the floodgates for thousands of new drilling permits to be approved? Or, will this document seriously and scientifically address public health and environmental impacts, as thousands of citizens and organizations have requested? If so, it is likely to be quite different, and thus many people believe a second public comment period should be provided, as was done for the burn barrel regulations, which received only 1,800 public comments. To express an opinion on this, write the DEC and the governor of New York.

### **Hydraulic Fracturing, Horizontal Drilling, Chemicals, and Fresh Water Withdrawn:**

Until now, gas wells in our area have been drilled into other rock layers, such as the Trenton-Black River limestone, in which the gas is located in large, pressurized pockets: once you have drilled into a pocket, the gas comes right out.

To extract the dispersed gas in the Marcellus shale, companies drill vertically to the shale and then turn and drill horizontally, up to a mile or more. They then inject fluid (“fracking fluid”) under extremely high pressure to shatter the rock and release the gas trapped inside. This process, developed by Halliburton, is called hydraulic fracturing, or hydrofracking. Limestone formations typically are not hydrofracked.

Although hydraulic fracturing has been used in NY since the 1940s, it has not been done on horizontal wells, and it only has been done using water mixed with gels or foams and other chemicals.<sup>18</sup> This more traditional process uses 20,000 to 80,000 gallons of fluid per fracturing, including about 700 to 2,800 lbs. of chemical additives.<sup>19</sup>

The new type of hydraulic fracturing to be used in the Marcellus shale, developed in the late 1990s, is called “slick water hydraulic fracturing.” It uses different chemicals--reducing the amount of gelling agents and adding friction reducers (thus the term “slick”)--and requires much more fluid. Because of the increased fluid, it also is known as “high-volume hydraulic fracturing.”<sup>20</sup>

High-volume hydraulic fracturing injects 2 to 7.8 million gallons of fluid per fracking<sup>21</sup> (on average 5.6<sup>22</sup>), and it is possible that wells may be fracked many times over their life spans. Thus, high-volume hydraulic fracturing requires 70 to 300 times more fluid than past wells. More fluid means more chemicals: 5.6 million gallons of fluid contains 205,000 to 935,000 pounds of chemical additives,<sup>23</sup> many of which are toxic to humans and wildlife.

Industry continues to claim that they have disclosed all the chemical ingredients in fracking fluid, and indeed, a list of nearly 200 specific chemicals industry says they plan to use in New York State appears in the draft SGEIS.<sup>24</sup> The fine print states, however, that there are 45 products for which DEC has incomplete ingredients (see Table 5.3) and 40 compounds whose ingredients are unknown because they are mixtures (Section 5.4, page 5-34). Apparently other chemicals may be used as well, but they were not submitted to DEC, so do not appear in the list. To find out which chemicals are used at a particular well, even one on or under your own property, you must submit a Freedom of Information Law (FOIL) request. You may then obtain a list of the nonproprietary chemicals used and the trade names of the ones considered proprietary (but not their ingredients). Thus, there is still no list of all the chemicals to be used in NY state and no way to determine all the chemicals used at a particular well.

Scientists analyzing samples from the numerous spills around the country and from MSDS sheets and other documents have identified more than 200 chemicals actually used in hydraulic fracturing. Among the most dangerous are the petroleum distillates, which include toluene, xylene, and benzene, a known carcinogen toxic at very low doses. Based on data in the SGEIS, under some scenarios, more water than is used by New York City in a single day may be required to dilute to an allowable level the benzene used at just one well. In some cases, more water may be required than is used by the entire state of New York on a single day.<sup>25</sup> Other toxic chemicals used include formaldehyde, kerosene, naphthalene, methanol, ethylene glycol (antifreeze), and hydrochloric acid.<sup>26, 27</sup> Many of the fracking fluid ingredients cause cancer, mutations, nervous system disorders, developmental disorders, skin and lung problems, endocrine disruption, and reproductive damage; 65 of them are classified as hazardous.<sup>28</sup>

The fresh water used for hydrofracking is withdrawn from local streams, lakes, and aquifers free of charge—a local gift to the gas industry. How much is 5.6 million gallons? It is 1.9 times the 2.98 million gallons the City of Ithaca draws from Six Mile Creek each day to supply 30,000 people.<sup>29</sup>

Wells can be drilled as close as 50 feet from surface water (the same surface water setback required for septic tanks), 100 feet from a residence, and 150 feet from a public building, such as a school.<sup>30</sup>

Because of concerns over the impact of hydraulic fracturing on water, congress has directed the EPA to conduct a study of the process and its effects.<sup>31,32</sup> The Science Advisory Board has prepared draft recommendations on the scope of the project, which are open to public comment until June 9, 2010.<sup>33</sup>

### **Toxic Waste Disposal:**

Some of the fracking fluid comes back out (perhaps 30 to 70%, but recent estimates hover around 15%<sup>34</sup>), but the fate of the rest is unknown: does it stay trapped in the shale, or move through soil and rock layers, sometimes reaching underground water supplies? But what comes out (termed “flowback”) is even more hazardous than what went in because fracturing releases radioactive materials such as radon and radium; heavy metals such as arsenic, barium, cadmium, lead, and mercury; and many salts from the shale. Some drilling enthusiasts have suggested that “green” fracking fluids might eliminate all the soil, air, and water pollution created by drilling, but the sad reality is that even if pure water were used in place of fracking fluid, the resulting flowback would still be laced with toxic chemicals brought out from the shale.

Once drilling is completed and the well is producing natural gas, it continues to generate waste fluids because the gas comes out of the ground mixed with water. This “produced water” or “brine” is toxic, and must be trucked away continually. The DEC has found radium-226 levels in produced water from several vertical Marcellus wells in the Southern Tier that are 267 times higher than the safe discharge limit and thousands of times higher than the limit for drinking water.<sup>35,36</sup> In many areas, produced water is spread on roads in the winter.

The result of both drilling and production is millions of gallons of very toxic fluid, which presents a huge disposal problem. One option is treatment, but few, if any, existing waste treatment facilities in New York will be able to handle waste flowback fluid without violating their discharge limits. Municipal waste treatment plants are designed to handle household wastes, not industrial chemicals, and thus do not remove most of the toxins in flowback, so many end up in the environment. One example is the total dissolved solids (TDS) remaining in flowback, which cause it to be extremely salty—as much as five times saltier than sea water.<sup>37</sup> High salt levels kill aquatic life in the surface waters to which they are discharged. In 2008, the Monongahela River in Pennsylvania had such high levels of TDS that U.S. Steel and Allegheny Energy, which use the river water, complained that it was corroding their machinery. The TDS level was thought to result from sewage treatment plants accepting, attempting to treat, and then discharging, drilling wastewater to the river.<sup>37</sup> The SGEIS suggests that NY toxic waste may need to be trucked to appropriate facilities in Pennsylvania, but Pennsylvania is already well over its capacity.<sup>38,39</sup>

Another disposal option, “deep-well injection,” involves pumping the waste into new, abandoned, or non-producing wells to store the wastes. These disposal wells are highly controversial because nothing is known of their long-term safety: toxic water may migrate through fractures in the rock layers and contaminate local aquifers and drinking wells. In October 2009, Chesapeake Energy submitted a permit application to the DEC to create a disposal well in a former Trenton-Black River well in Pulteney, NY, less than 1 mile west of Keuka Lake. After massive local opposition, the company withdrew its application. The company had planned to inject up to 181,440 gallons of toxic brine per day for 10 years from hydrofracked wells in NY and PA.<sup>40,41</sup> A concern for many communities just outside the most profitable parts of the Marcellus shale is that their land may be used for disposal wells and waste treatment plants.

Waste fluid also may be stored on site temporarily in open, plastic-lined lagoons. These may leak and are hazardous to wildlife: animals attracted to the salts drink from it and are poisoned. According to Horwitt<sup>25</sup> (p. 15), “New Mexico’s Oil Conservation Division has identified more than 400 cases of groundwater contamination from oil and gas waste pits statewide.” Furthermore, some of the chemicals that evaporate from open pits cause air pollution. The SGEIS (p. 5-113) states that some drilling companies plan to pool their flowback from within a 4-mile radius in huge open storage lagoons of up to 5 acres, holding 16 million gallons of toxic waste. On p. 6-129, the SGEIS states that “Emission of

Hazardous Air Pollutants (HAPs)... could exceed ambient air thresholds 1,000 meters (3,300 feet) from the impoundment and could cause the impoundment to qualify as a major source of HAPs.”

Alternatively, waste may be stored on site in huge steel tanks; these create the fewest environmental hazards, but are not required in New York.<sup>42</sup>

The switch to high-volume hydraulic fracturing increases dramatically the magnitude of the toxic waste disposal problems created by gas extraction: Dr. Stephen Penningroth of the Community Science Institute has pointed out that, given the greater volume of fluid used in high-volume hydraulic fracturing (using a value of 100x more), the drilling of 1 well per 40 acres (16 wells per square mile) in the Marcellus shale creates an amount of toxic fluid the equivalent of 1,600 traditionally-drilled wells per square mile (vertical wells, using “non” high-volume hydraulic fracturing).<sup>43</sup>

### **Water Contamination Risk:**

Despite industry claims to the contrary, thousands of problems, including spills, leaks, and the seepage of contaminants into drinking water supplies, have been documented in conjunction with gas extraction by hydraulic fracturing around the country.<sup>44, 45, 46, 47, 48, 49</sup> Houses, water wells, and pipelines have exploded, and people have found methane levels in their water so high that they could light it with a match.<sup>50, 51, 52</sup>

The gas industry<sup>53</sup> and the DEC<sup>54</sup> claim that spills and accidents are very rare events, and nothing to worry about. But, when tens of thousands of wells are drilled in a region, even a tiny error rate can result in hundreds of problems. What is the accident rate? Dr. Ron Bishop has obtained data from health officials across New York State and from several other states where gas drilling has taken place. From that data he calculated a 1 to 2% chance of groundwater contamination and a 5 to 8% chance of groundwater contamination or surface impacts (such as sedimentation of surface water or chemical pollution of soil, streams, or lakes).<sup>55</sup> A 2007 Penn State Cooperative Extension study of 200 water wells near oil and gas wells found 8% contaminated.<sup>56</sup> Contamination from just 1% of the 2,600 to 4,000 gas wells expected in Tompkins County (see Endnotes 8 & 9) would mean 26 to 40 separate incidents of groundwater contamination, but it only takes one chemical spill to contaminate an aquifer and ruin the drinking water for an entire region. Once an aquifer is contaminated, it can rarely, if ever, be cleaned up. An error rate of this magnitude in the airline industry (1% of 8.8 million U.S. commercial domestic flights/year)<sup>57</sup> would mean 88,000 crashes in the U.S. each year. This would probably not be acceptable.

Although human error and regulation short-cutting often may be to blame, even more disturbing concerns arise from the imprecise nature of hydrofracking itself: when gas companies fracture the shale, they do not have complete control over exactly where fractures will develop, so fracturing fluids and natural gas can move in unexpected directions,<sup>58</sup> ending up in aquifers and water wells.

Dr. Penningroth also has suggested some possible failure rates for gas wells. He assumes a 3% chance that human error may cause a problem with the drilling technology, and a 2% chance that the geology of a site may cause unexpected results during fracturing, both leading to groundwater contamination. He concludes, “This would mean, on average, that if everything goes perfectly 95% of the time, one well of the 16 wells per square mile will be predicted to fail.”<sup>59</sup>

A further concern in NY is the existence of 18,000 to 48,000 abandoned oil and gas wells that have not been plugged.<sup>60</sup> During hydrofracking and deep-well injection, the high pressure can force toxic fluids up through any existing unplugged wells in the area, contaminating aquifers and drinking wells.<sup>61</sup>

### **Air and Noise Pollution:**

Gas extraction generates air pollutants such as benzene, toluene, xylene, methane, nitrogen oxides, particulates, and sulfur compounds.<sup>62</sup> These come from many sources, including diesel generators, trucks, drill rigs, condensate tanks, evaporation from open pits of flowback and other toxic fluids, compressors, venting, routine gas leaks (fugitive emissions), and well flaring.<sup>63, 64, 65</sup> Some air pollutants interact with sunlight to produce ozone,<sup>66</sup> which causes numerous respiratory problems and aggravates others, such as asthma. Recent evidence demonstrates that long-term exposure to even low levels of ozone significantly

increases one's risk of death from respiratory illness.<sup>67</sup> In formerly pristine parts of rural Wyoming, gas drilling at the well density allowed in our area has created ozone levels similar to the worst ozone days in Los Angeles.<sup>68, 69, 70</sup>

Furthermore, gas extraction is noisy: drill rigs, construction vehicles, and truck traffic create a great deal of noise.<sup>71, 72</sup> The biggest offenders, however, are compressor stations, which will be required to bring the gas pressure in smaller gathering pipelines up to the pressure in larger transmission pipelines. The draft SGEIS (Section 5.16.8, p. 5–130) says that each compressor station will service gas wells within a 4-to-6-mile radius (this comes to roughly 5 or 6 compressor stations for an area the size of Tompkins County). Compressor station noise is the same level as a propeller plane flying overhead or a concrete mixer—but they operate 24 hours a day, 7 days a week.<sup>73</sup> Compressors also may be used at individual wells when the gas pressure is low. In DISH, Texas, the 11 compressor stations have caused levels of toxic air pollutants such as benzene, xylene, and naphthalene many times higher than allowable standards; residents have developed respiratory ailments, brain disorders, pre-cancerous lesions, and other health problems.<sup>74, 75, 76</sup>

### **Regulations:**

The oil and gas industry, as a result of its massive wealth and lobbying power, is exempt from the federal Clean Water Act (including wetlands protection), the Clean Air Act, Superfund Law (CERCLA), the Safe Drinking Water Act, the Resource Conservation and Recovery Act (RCRA), the Toxic Release Inventory of the Right to Know Act, and parts of the National Environmental Policy Act.<sup>77</sup> The RCRA exemption is almost comical in its application: although 65 of the chemical constituents of fracking fluid are classified as hazardous under federal laws, the gas industry is exempt from having to treat them as hazardous once they have come back out of a well.<sup>78</sup> (The unused, leftover portions of these chemicals, however, must be treated as hazardous waste if they do not actually participate in fracking!)

Moreover, in 1981 New York Environmental Conservation Law 23-0303 was amended to remove the right of towns and counties to regulate gas drilling, except in the areas of road use and real property taxes.<sup>79</sup> There is currently some controversy over whether local ordinances that determine appropriate land use (such as planning laws) will apply to the gas industry.

This leaves mainly the DEC to regulate and oversee gas drilling. But, the DEC itself has leases on 63,591 acres of state land (including the 915-acre Potato Hill in Caroline and the 1,937-acre Robinson Hollow in Richford), which in 2008 earned \$2.1 million for New York,<sup>80</sup> raising potential conflicts of interest. More concerning is that the DEC has only 17 field inspectors<sup>81</sup> for the more than 13,000 oil and gas wells already active in the state.<sup>82</sup> What level of environmental oversight can be provided with such limited staff?<sup>83</sup>

### **Impacts on Landowners:**

Already, at least 39% of the land area in Tompkins County has been leased to gas companies, although that land is owned by only 6% of the adult, non-college-student population.<sup>84</sup> Thus, few residents will directly benefit from gas drilling, though all will experience the adverse impacts. Most leases grant surface rights, which allow activities such as drilling, access road construction, and long-term storage of fracking fluids. Landowners receive money when they sign leases (signing bonuses) and as royalty payments, if a productive well is drilled on or extends below their property. Some welcome the much-needed money, but others are alarmed and regret leasing; at the time they signed, high volume hydraulic fracturing was not being used here. Furthermore, leaseholders may be sued by neighbors over damages caused by gas drilling.

Landowners trying to sell property are discovering that many people do not want to buy land with gas leases or next to leased parcels, and some banks rarely give mortgages or loans to people buying homes on land with gas leases—unless surface rights are removed.<sup>85, 86</sup> Prospective homebuyers also may avoid properties with gas leases because they may not be eligible for FHA financing. The HUD Handbook 4150.2, page 2.7, states: "No existing dwelling may be located closer than 300 feet from an

active or planned drilling site. Note that this applies to the site boundary, not to the actual well site."<sup>87</sup> One informal survey of mortgage officers found that many interpreted this to mean that people buying a home within 300 feet of the boundary of any leased property are not eligible for FHA financing.<sup>88</sup> In states already experiencing drilling, people whose drinking water supplies are contaminated or who live near large drilling operations are finding their property values decreasing dramatically.<sup>89,90</sup> Standard homeowners' insurance does not cover pollution damage from drilling, foundation damage from seismic testing, or damage claims from neighbors.<sup>91</sup>

Landowners near gas drilling are strongly advised to get their private water wells and surface water tested by a state-certified lab before drilling begins (a cost of approximately \$500 per source). If no pretesting is done, they will be unable to prove fault, and thus have no hope of receiving compensation if their water becomes contaminated.<sup>92</sup>

### **Compulsory Integration/Eminent Domain:**

If at least 60% of the land area around you is leased, you may be forced to have your land included in a spacing unit.<sup>93,94</sup> This "compulsory integration" allows the gas company to drill horizontally and inject toxic fracking fluids under your property, but not to set foot on your land. They must pay you the standard 12.5% royalty for any gas they take. Even if you are not forced into a spacing unit, eminent domain may be used to site compressor stations or to route pipelines across your land.

### **Economic and Societal Impacts on Communities:**

Many communities have incurred high costs for hosting large-scale industrialization. Traffic is a huge problem: the fracking of just one well requires about 1,540 tanker truckloads of water and waste<sup>95</sup> and 220 to 364 additional trips for bringing in equipment, materials, and employees.<sup>96</sup> So, a typical well pad with 7 wells drilled from it would add about 13,000 round-trip truck trips to local roads. With increased traffic and industrial-scale construction comes much dust and noise, but there also are significant monetary costs: repair of severe road and bridge damage from heavy trucks,<sup>97</sup> and increased emergency response personnel and training to deal with spills, chemical fires, explosions, and traffic accidents.<sup>98,99</sup> And, what effect will industrialization and pollution have on our local industries, such as farming, wineries, outdoor recreation, and tourism, which bring in much more revenue than is projected from natural gas?<sup>100</sup>

The existing economic studies debunk the popular myth that gas extraction benefits the economies of communities. A study in the western United States comparing gas-reliant counties to those without gas drilling found that over the long term, those relying on gas drilling had a greater gap between high and low income households, less ability to attract investment and retirement dollars, and economies that grew more slowly.<sup>101</sup> A comprehensive review of over 300 findings from 19 major economic studies that measured the effect of resource extraction on local, nonmetropolitan communities found that they were better off in only a quarter of the cases (in half of the findings the communities were worse off; in the remaining quarter there was no change).<sup>102</sup> Furthermore, data from each county in New York State show no correlation between the change in gas production and the change in per capita income, adjusted for inflation, between 2000 and 2007. Some counties, such as Steuben, increased gas production by 250% and yet their net per capita income decreased.<sup>103</sup>

The nature of communities also changes with gas extraction. Many gas industry jobs are specialized and employ transient, out-of-state workers—particularly males in their 20s and 30s. The influx of these workers and many others who become residents change the social structure of a community. Studies of other rural areas experiencing rapid industrialization from gas drilling have found high cost-of-living increases (especially in housing and rent), significant inflation, and rising numbers of medical visits, ambulance trips, court cases, arrests, and crimes.<sup>104</sup> Long-term residents report lower satisfaction with their community and quality of life.

### **The Larger Picture:**

Some argue that we should support natural gas because it releases fewer greenhouse gases than coal or oil *when it is burned*. Preliminary analysis by Prof. Robert Howarth of Cornell University, however, shows that when the entire life cycle of each fossil fuel is considered (including the emissions during extraction and transmission), the global warming impact of natural gas may be comparable to that from coal and 60% greater than that from oil.<sup>105</sup> A key factor in this calculation is the rate of routine leaking of methane (the major component of natural gas), which EPA data show to be 1.5 to 2%.<sup>106</sup> Some evidence indicates that this is a conservative estimate of the leakage rate.<sup>107,108</sup> Because methane is 72 times more potent a greenhouse gas than carbon dioxide,<sup>109</sup> even a small amount leaking into the atmosphere during gas extraction can have a large impact on global warming.

Other people argue that we should support natural gas because it will reduce our dependence on foreign oil, but oil and natural gas are used for very different purposes (in the United States, about two-thirds of oil use is for transportation), so gas will not significantly displace oil without major changes in our society.<sup>110</sup> Alan Krueger, Assistant Secretary for Economic Policy at the US Treasury, has stated that using less oil and investing in clean energy technologies would increase energy security more than would increasing domestic fuel production.<sup>111</sup>

How much will the Marcellus shale of New York contribute to the nation's energy needs? Estimates seem to keep springing upward as gas companies seek more investors,<sup>112,113</sup> but in reality, it is too early to know the true size of the resource. Any estimate requires many assumptions, such as (1) how productive wells in NY will be compared to those in PA, (2) the rate of decline in gas production from Marcellus wells (the rate at which gas is produced from a shale gas well declines about 50% in the first year, and continues to decline throughout the well's lifetime), and (3) the rate at which wells will be drilled in New York. Even using the most optimistic estimate for the size of the Marcellus shale reserve, and assuming that 2,000 new wells are drilled in New York each year (768 Marcellus wells were drilled in PA in 2009), New York's share of the Marcellus gas adds less than 2% to the annual energy used in the United States.<sup>114</sup> Coal accounts for 23% of the annual energy supply,<sup>115</sup> so even if all the gas were used to replace coal, it would only reduce our coal consumption by 10%.

Gas looks much less rosy when the environmental, health, and societal costs of its extraction are considered. Moreover, it is still a fossil fuel—and its extraction, leaking, and burning contribute significantly to global warming. We *must* ask the critical questions: To what lengths and environmental destruction are we willing to go to delay the inevitable switch to true alternative energy, such as solar, water, and wind power? Will we destroy the Arctic National Wildlife Refuge, our offshore fisheries, the remaining mountains of West Virginia, and the Finger Lakes Region to get at every last drop and wisp of fuel? How can we effectively change our National Energy Policy so that no person and no area must bear these burdens? Are we going to apply the lessons learned from the Gulf Oil Disaster, or sweep them under the rug once the shock wears off?

Even as we continue to use fossil fuel, it is unconscionable not to ask: Are there some places whose best uses, even though they harbor vast amounts of fossil fuel, are tourism, recreation, wilderness, wildlife habitat, farming, wine-producing, or peaceful country living?

## What Can We Do?

People concerned about gas drilling in our area can do the following:

- (1) Learn as much as you can about high-volume hydraulic fracturing, and make sure your friends and neighbors are aware of the issues.
- (2) Join one or more of the local groups opposing gas drilling:
  - Shaleshock** (active grassroots coalition in Tompkins and nearby counties) [www.shaleshock.org](http://www.shaleshock.org)
  - FleasEd** (group of leaseholders with regrets) [www.fleasEd.org](http://www.fleasEd.org) email: [fleasEdny@gmail.com](mailto:fleasEdny@gmail.com)  
or search "FleasEd New York" on Facebook
  - ROUSE** (Residents Opposing Unsafe Shale-Gas Extraction: new Tompkins County regional group emphasizing neighbor-to-neighbor communication) email: [rousetc@gmail.com](mailto:rousetc@gmail.com)
  - DRAC** (Dryden Resource Awareness Coalition) [www.draconline.wordpress.com](http://www.draconline.wordpress.com)
  - ENSAW** (Enfield Neighbors for Safe Air and Water) [www.ensaw.org](http://www.ensaw.org) or Beth: 607-387-9899
  - Danby Gas Drilling Task Force** Contact: Kathy Halton: [khalton@twcny.rr.com](mailto:khalton@twcny.rr.com) 607-273-0533  
<http://town.danby.ny.us/GasDrill>
  - KyotoNOW!** (Cornell students fighting climate change) [www.rso.cornell.edu/kyotonow](http://www.rso.cornell.edu/kyotonow)
  - NYRAD** (NY Residents Against Drilling: a well-organized Binghamton Group) [www.nyrad.org](http://www.nyrad.org)
  - GDDAC** (Gas Drilling Awareness for Cortland County) [www.gdacc.wordpress.com](http://www.gdacc.wordpress.com)
  - CHC** (Citizens for Healthy Communities) Elmira area group phone: 607-329-5883
  - SCCC** (Seneca County Concerned Citizens) email: [janq99@gmail.com](mailto:janq99@gmail.com) Jan: 607-532-9288
- (3) Ask your state and federal legislators to tell Governor Paterson and Pete Grannis (the head of the DEC) to ban high-volume hydraulic fracturing in New York, at least until credible, independent, peer-reviewed scientific studies, not funded or influenced by the gas industry, have proven its safety to our health and the environment.
 

Furthermore, you can support State Assembly Bill A10490 and State Senate Bill S7592, which place a moratorium on hydraulic fracturing until 120 days after the EPA study comes out.
- (4) Contact your state legislators and ask that ECL Section 23-0303 be amended to restore the ability of local governments to enforce zoning, noise, and other local ordinances to protect their residents and sensitive areas.<sup>116, 117</sup> Ask, also, that local governments become involved agencies for SEQR review, which will aid their requesting environmental review of drilling permits issued in sensitive local areas. In addition, request that local government officials be notified immediately when drilling permits are issued within their jurisdiction. Furthermore, you can support Assembly Bill A10633, which addresses ECL Section 23-0303 to clarify that it allows municipalities control over *land use* (zoning), but not *regulation* (for example, applying a noise ordinance) of the oil and gas industry.
- (5) Contact your local officials to make sure they are preparing for gas drilling: setting up overweight vehicle taxes, enhancing emergency response preparedness, collecting baseline data on the quality of land, air, and water and on sensitive areas, and developing taxes to insure that gas companies, and not residents, pay for the damages resulting from gas drilling.<sup>118, 119, 120</sup>
- (6) Fax or call your US Representatives and Senators to request their support of the Frac Act: H.R. 2766 and S.1215. These bills repeal the Safe Drinking Water Act Exemption and require public disclosure of the chemicals in fracking fluid.<sup>121</sup>
- (7) See other actions at:
  - [http://www.tcgasmap.org/default.asp?metatags\\_Action=Find\('PID','11'\)](http://www.tcgasmap.org/default.asp?metatags_Action=Find('PID','11'))
  - <http://www.nyrad.org/actnow.html>
  - <http://www.shaleshock.org/wp-content/uploads/2009/11/helping-gas-drilling-booklet-single-sided-copy.pdf>
  - <http://www.catskillmountainkeeper.org/node/310>

## Fact Sheets with More In-depth Information and References:

[http://www.tcgasmap.org/default.asp?metatags\\_Action=Find\('PID','19'\)#Handouts on Key Topics](http://www.tcgasmap.org/default.asp?metatags_Action=Find('PID','19')#Handouts on Key Topics)

## Contact Info for DEC Personnel and Federal, State, and Local Elected Officials:

<http://www.tcgasmap.org/media/Elected%20Officials%20Representing%20Tompkins%20County.pdf>

## Web Sites for Further Information:

### Hydraulic Fracturing Information and Activism:

<http://www.shaleshock.org/> (local)

<http://www.tcgasmap.org/> (local)

<http://www.nyrad.org/> (regional)

<http://www.catskillmountainkeeper.org/node/290>

<http://www.catskillcitizens.org/learn.cfm>

<http://www.un-naturalgas.org/index.htm>

[http://www.earthworksaction.org/oil\\_and\\_gas.cfm](http://www.earthworksaction.org/oil_and_gas.cfm)

### Collections of Articles on Gas Drilling:

<http://www.propublica.org/series/buried-secrets-gas-drillings-environmental-threat> (national)

<http://marcelluseffect.blogspot.com> (local and regional)

## Endnotes

<sup>1</sup> New York State Department of Environmental Conservation. September 2009. “Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program” (dSGEIS) Section 4.2, Figure 4.1, p. 4–5. <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf>

<sup>2</sup> dSGEIS, Section 4.4, Figure 4.8, p. 4–19.

<sup>3</sup> Size estimates of the Marcellus shale gas vary from 50 trillion cubic feet (Engelder T., and Lash, G.G. 2008. “Marcellus shale play’s vast resource potential creating stir in Appalachia.” *American Oil and Gas Reporter*, v. 51, No. 6, pp. 76–87) to 489 trillion cubic feet (see Endnote 7 for full citation). Neither number has been validated through scientific peer-review. At the current gas price of \$4 per thousand cubic feet, these two estimates yield a value of \$200 billion and \$2.0 trillion, respectively.

<sup>4</sup> dSGEIS, Section 5.2, p. 5–26.

<sup>5</sup> dSGEIS, Section 5.1.2 and Section 5.1.3.2, Table 5–1, p. 5–20.

<sup>6</sup> dSGEIS, Section 5.1.3.2, p. 5–19, “Horizontal Wells with Multiple Wells Drilled from Common Pads.”

<sup>7</sup> Engelder, T. 2009. Marcellus 2008: Report Card on the Breakout Year for Gas Production in the Appalachian Basin. *Fort Worth Basin Oil & Gas Magazine*. August 2009.

<sup>8</sup> The total land area of Tompkins County is 305,250 acres. 70% of this is 213,675 acres. Assuming a well pad with 8 wells every square mile (640 acres) results in 2,600 wells.

<sup>9</sup> No hard figures exist for the number of wells that will be drilled. Administrators in Tompkins and Broome Counties are expecting 4,000 wells in each county. See, for example, the draft SGEIS Comments by Tompkins County Planning Department (<http://www.tcgasmap.org/media/Town of Ithaca Comments on Draft SGEIS.pdf>) and a report prepared for Broome County (Weinstein, B.L. and Clower, T.L. September 2009. “Potential Economic and Fiscal Impacts From Natural Gas Production in Broome County, New York” [http://www.gobroomecounty.com/files/law/Marcellus-Broome\\_County\\_7\\_10\\_09.pdf](http://www.gobroomecounty.com/files/law/Marcellus-Broome_County_7_10_09.pdf))

- <sup>10</sup> State Environmental Quality Review Act (SEQRA) Regulations. NYS DEC Regulations Section 617. [www.dec.ny.gov/regs/4490.html](http://www.dec.ny.gov/regs/4490.html)
- <sup>11</sup> dSGEIS, Section 1.4.
- <sup>12</sup> New York State Department of Environmental Conservation. 1992. "Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program (GEIS)" [www.dec.ny.gov/energy/45912.html](http://www.dec.ny.gov/energy/45912.html)
- <sup>13</sup> NYS DEC, 2010. "DEC Announces Separate Review for Communities with 'Filtration Avoidance Determinations.'" April 23, 2010. <http://readme.readmedia.com/DEC-Announces-Separate-Review-for-Communities-with-Filtration-Avoidance-Determinations/1239367>
- <sup>14</sup> Navarro, Mireya. 2010. "State Decision Blocks Drilling for Gas in Catskills," *New York Times*. April 23, 2010. <http://www.nytimes.com/2010/04/24/science/earth/24drill.html?ref=nyregion>
- <sup>15</sup> See, for example, the comments posted at: [www.tcgasmap.org/default.asp?metatags\\_Action=Find\('PID','9'\)#Comments on SGEIS](http://www.tcgasmap.org/default.asp?metatags_Action=Find('PID','9')#Comments on SGEIS)
- <sup>16</sup> New York City Department of Environmental Protection. December 22, 2009. "New York City Comments on: Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Mining Regulatory Program – Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs." [http://www.tcgasmap.org/media/NYC\\_DEP\\_Draft\\_SGEIS\\_Comments.pdf](http://www.tcgasmap.org/media/NYC_DEP_Draft_SGEIS_Comments.pdf)
- <sup>17</sup> Letter from Alexander Grannis, DEC Commissioner, to Assemblyman William Magee. [http://www.tcgasmap.org/media/Michelle\\_Bamberger\\_Comments\\_on\\_Draft\\_SGEIS.pdf](http://www.tcgasmap.org/media/Michelle_Bamberger_Comments_on_Draft_SGEIS.pdf) (See p. 29.)
- <sup>18</sup> Grannis, Alexander. October 15, 2008. Testimony at NYS Assembly Hearing on Oil and Gas Drilling. <http://www.dec.ny.gov/energy/47910.html>
- <sup>19</sup> Chemical additives used in water gel hydraulic fracturing are gels (20 lbs. per 1,000 gallons), surfactants (1 gallon per 1,000 gallons), and small amounts of bactericides, iron controllers, and clay stabilizers (GEIS, Chapter 9, Section F, pp. 9–26 and 9–27; see Endnote 6 for full citation). Assuming the surfactant density is around 10 lbs./gallon (just slightly more dense than water) and taking bactericide, iron control, and clay stabilizer concentrations as given in the dSGEIS (Chapter 5, Section 5.4.3, p. 5–44), the weight of chemicals in a water gel hydraulic fracture is roughly 35 lbs/1,000 gallons. Water gel hydraulic fracturing uses 20,000 to 80,000 gallons of water (GEIS, Chapter 9, Section F, p. 9–26; see Endnote 6 for full citation), so 700 to 2,800 lbs. of chemicals are used.
- <sup>20</sup> New York State Department of Environmental Conservation. February 2009. "Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Mining Regulatory Program," Section 2.1.2. [http://www.dec.ny.gov/docs/materials\\_minerals\\_pdf/finalscope.pdf](http://www.dec.ny.gov/docs/materials_minerals_pdf/finalscope.pdf)
- <sup>21</sup> dSGEIS, Section 5.62, p. 5–73.
- <sup>22</sup> Water Use in Marcellus Deep Shale Gas Exploration: Fact Sheet, March 2010. Chesapeake Energy Corporation. [http://www.chk.com/Media/MarcellusMediaKits/Marcellus\\_Water\\_Use\\_Fact\\_Sheet.pdf](http://www.chk.com/Media/MarcellusMediaKits/Marcellus_Water_Use_Fact_Sheet.pdf)
- <sup>23</sup> The typical percentage of chemicals in hydraulic fracturing solutions for the Fayetteville Shale is reported as 0.44% by weight (SGEIS, Section 5.4.3, p. 5–44). 0.44% by weight of 5.6 million gallons is 205,000 lbs. (water weighs 8.34 lb./gallon). The SGEIS also states that chemical additives typically comprise 2% or less of the fracturing fluid (Section 5.4, p. 5–33). 2% by weight of 5.6 million gallons is 935,000 lbs.
- <sup>24</sup> dSGEIS, Section 5.4.3, pp. 5–44 through 5–51.
- <sup>25</sup> Horwitt, Dusty. 2009. "Drilling Around the Law." *Environmental Working Group Report*. <http://www.ewg.org/files/EWG-2009drillingaroundthelaw.pdf>
- <sup>26</sup> The Endocrine Disruption Exchange (TEDX) has done a lot of ground-breaking work in identifying chemicals in fracking fluid. An Excel spreadsheet with data on the chemicals they have identified is at <http://www.endocrinedisruption.com/chemicals.fracturing.php>

- <sup>27</sup> Berkowitz, M. November 2009. “Toxic Chemicals on Tap: How Natural Gas Drilling Threatens Drinking Water.” Environment America Research and Policy Center Publication. <http://www.environmentamerica.org/uploads/4f/e0/4fe0dcbda2ad62ab03a8440346c90cd8/AME-toxics-report-final-lo-res.pdf>  
(See pp. 4–5 for information on the inclusion of benzene, toluene, and formaldehyde).
- <sup>28</sup> Environmental Working Group. June 10, 2008. “Colorado's Chemical Injection.” <http://www.ewg.org/book/export/html/26648>
- <sup>29</sup> City of Ithaca, *2009 Drinking Water Quality Report*, Table 1, p. 3. <http://www.cityofithaca.org/vertical/Sites/%7B5DCEB23D-5BF8-4AFF-806D-68E7C14DEB0D%7D/uploads/%7B03EB90C7-A888-4A48-8C66-B0B67A439D17%7D.PDF>
- <sup>30</sup> Generic Environmental Impact Statement (GEIS), p. 8–3. [http://www.dec.ny.gov/docs/materials\\_minerals\\_pdf/dgeisv1ch8.pdf](http://www.dec.ny.gov/docs/materials_minerals_pdf/dgeisv1ch8.pdf).  
(The setbacks mentioned in this article, and many others, were not changed in the draft SGEIS.)
- <sup>31</sup> See the EPA Science Advisory Board website, which has a wealth of information on this study, including the draft scope and public comments. <http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/4caa95a38952145f852576d3005daa17!OpenDocument&Date=2010-04-07>
- <sup>32</sup> Lustgarten, Abrahm. March 18, 2010. “EPA Launches National Study of Hydraulic Fracturing.” *ProPublica*. <http://www.propublica.org/feature/epa-launches-national-study-of-hydraulic-fracturing>
- <sup>33</sup> Science Advisory Board Draft Report on the EPA’s Research Scoping Document Related to Hydraulic Fracturing. May 19, 2010. [http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/CC6B2E8803C9BFB985257729004F980F/\\$File/Advi+on+EPA%E2%80%99s+Res+Scoping+Doc+Related+to+Hydraulic+Fracturing+\\_5-19-10+draft.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/CC6B2E8803C9BFB985257729004F980F/$File/Advi+on+EPA%E2%80%99s+Res+Scoping+Doc+Related+to+Hydraulic+Fracturing+_5-19-10+draft.pdf)
- <sup>34</sup> Lustgarten, A. December 27, 2009. “In New Gas Wells, More Drilling Chemicals Remain Underground.” *ProPublica*. <http://www.propublica.org/feature/new-gas-wells-leave-more-chemicals-in-ground-hydraulic-fracturing>
- <sup>35</sup> Lustgarten, A. November 9, 2009. “Is New York’s Marcellus Shale Too Hot to Handle?” *ProPublica*. <http://www.propublica.org/feature/is-the-marcellus-shale-too-hot-to-handle-1109>
- <sup>36</sup> Mantius, P. November 13, 2009. “Schuyler’s Hot.” *The Odessa File*. <http://odessafile.com/features-Mantius3.html>
- <sup>37</sup> Sapien, J. October 3, 2009. “With Natural Gas Drilling Boom, Pennsylvania Faces an Onslaught of Wastewater.” *ProPublica*. <http://www.propublica.org/feature/wastewater-from-gas-drilling-boom-may-threaten-monongahela-river>
- <sup>38</sup> Sapien, J. and Shankman, S. December 29, 2009. “Drilling Wastewater Disposal Options in N.Y. Report Have Problems of Their Own.” *ProPublica*. <http://www.propublica.org/feature/drill-wastewater-disposal-options-in-ny-report-have-problems-1229>
- <sup>39</sup> Sapien, J. October 3, 2009. “With Natural Gas Drilling Boom, Pennsylvania Faces an Onslaught of Wastewater.” *ProPublica*. <http://www.propublica.org/feature/wastewater-from-gas-drilling-boom-may-threaten-monongahela-river>
- <sup>40</sup> Smith-Heavenrich, Sue. February 11, 2010. “Pulteney Residents Protest Planned Disposal Well.” *Broader View Weekly*. [http://www.tiogagaslease.org/images/BVW\\_02\\_11\\_10.pdf](http://www.tiogagaslease.org/images/BVW_02_11_10.pdf)
- <sup>41</sup> Seneca Lake Pure Waters Association. “Chesapeake Energy Proposal to Develop Injection Well in the Town of Pulteney: Status as of February 9, 2010.” [http://www.senecalake.org/MEETNOTES/Status of Pulteney Injection Well 020910.pdf](http://www.senecalake.org/MEETNOTES/Status%20of%20Pulteney%20Injection%20Well%20020910.pdf)
- <sup>42</sup> dSGEIS, Sections 5.11.2, 7.1.7, 7.1.74 and p. 7–32. (Section 7.1.74 acknowledges that tanks are safer than storage pits, but does not require tank storage.)

- <sup>43</sup> Penningroth, S. December 9, 2008. “Comments on Draft Scoping Document for Draft Supplemental Generic Environmental Impact Statement on Oil and Gas Drilling.” (See p. 6.)  
[http://www.communityscience.org/documents/Gas Wells - Comments on scoping document for dSGEIS, Dec.pdf](http://www.communityscience.org/documents/Gas_Wells_-_Comments_on_scoping_document_for_dSGEIS_Dec.pdf)
- <sup>44</sup> A listing of many news reports and studies of contaminated water is posted at:  
[http://www.tcgasmap.org/default.asp?metatags\\_Action=Find\('PID','21'\)#Water Contamination-General](http://www.tcgasmap.org/default.asp?metatags_Action=Find('PID','21')#Water Contamination-General)
- <sup>45</sup> Lustgarten, A. August 25, 2009. “EPA: Chemicals Found in Wyoming Drinking Water Might Be From Fracking.” *ProPublica*. <http://www.propublica.org/feature/epa-chemicals-found-in-wyo.-drinking-water-might-be-from-fracking-825>
- <sup>46</sup> McConnel, S. September 22, 2009. “Third Natural Gas Chemical Spill Reported.” *The Wayne Independent*.  
<http://www.wayneindependent.com/news/x1699593258/Third-natural-gas-chemical-spill-reported>
- <sup>47</sup> Lustgarten, A. November 20, 2008. “PA Residents Sue Gas Driller for Contamination, Health Concerns.” *ProPublica*. <http://www.propublica.org/feature/pa-residents-sue-gas-driller-for-contamination-health-concerns-1120>
- <sup>48</sup> Lustgarten, A. November 13, 2008. “Buried Secrets: Is Natural Gas Drilling Endangering U.S. Water Supplies?” *ProPublica*. <http://www.propublica.org/feature/buried-secrets-is-natural-gas-drilling-endangering-us-water-supplies-1113>
- <sup>49</sup> Thyne, G. December 20, 2008. “Review of Phase II Hydrogeologic Study.” (Report prepared for Garfield County, Colorado.) [http://s3.amazonaws.com/propublica/assets/methane/thyne\\_review.pdf](http://s3.amazonaws.com/propublica/assets/methane/thyne_review.pdf)
- <sup>50</sup> Lustgarten, A. July 31, 2009. “Water Problems from Drilling are More Frequent than PA Officials Said.” *ProPublica*. <http://www.propublica.org/feature/water-problems-from-drilling-are-more-frequent-than-officials-said-731>
- <sup>51</sup> Lustgarten, A. April 22, 2009. “Colorado Study Links Methane in Water to Drilling.” *ProPublica*.  
<http://www.propublica.org/feature/colorado-study-links-methane-in-water-drilling-422>
- <sup>52</sup> See <http://vimeo.com/4680635> for a video of a homeowner lighting his tap water on fire.
- <sup>53</sup> [http://www.fortunaenergy.com/how\\_we\\_operate/groundwater-protection.html](http://www.fortunaenergy.com/how_we_operate/groundwater-protection.html)  
(Click on “Groundwater Protection Article.”)
- <sup>54</sup> Wilbur, T. November 8, 2009. “Natural Gas Quest: State Files Show 270 Drilling Accidents in Past 30 Years.” *Ithaca Journal*. <http://www.theithacajournal.com/article/20091108/NEWS01/911080372/Natural-gas-quest--State-files-show-270-drilling-accidents-in-past-30-years>
- <sup>55</sup> Dr. Ron Bishop, private communication. Officials were asked about incidents of groundwater contamination (from methane or any other known industry product) and surface problems (chemical pollution of soil, sedimentation, and similar issues). Included in his analysis are responses from county health officials across New York and from state officials in Colorado, New Mexico, and Pennsylvania; states keep track of at least some of this data.
- <sup>56</sup> Clark, J., B. R. Swistock, and S. Clemens. 2007. Unpublished data collected from 200 private water wells in McKean County, noted in: <http://resources.cas.psu.edu/WaterResources/pdfs/gasdrilling.pdf>
- <sup>57</sup> [http://www.bts.gov/press\\_releases/2009/bts058\\_09/html/bts058\\_09.html#table\\_07](http://www.bts.gov/press_releases/2009/bts058_09/html/bts058_09.html#table_07)  
(See Table 7: 6,630,500 flights in the first 9 months of 2009 translates to 8.8 million per year.)
- <sup>58</sup> Quotes from industry research scientists on the uncertainty in hydraulic fracturing:  
[http://www.tcgasmap.org/media/Hydraulic Fracturing Predicting Difficulties Industry Source.pdf](http://www.tcgasmap.org/media/Hydraulic_Fracturing_Predicting_Difficulties_Industry_Source.pdf)
- <sup>59</sup> Penningroth, S. December 9, 2008. “Comments on Draft Scoping Document for Draft Supplemental Generic Environmental Impact Statement on Oil and Gas Drilling.” (See p. 4)  
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- <sup>60</sup> Interstate Oil and Gas Compact Commission. September 1994. “IOGCC/EPA Review of Oil and Gas Exploration and Production Waste Management Regulatory Programs: New York State Review.”  
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- <sup>61</sup> <http://splashdownpa.blogspot.com/2009/10/letter-from-wilma-subra-to-new-york.html>  
(See “A Letter from Wilma Subra to New York State,” and the section titled “Hydraulic Fracturing.”)
- <sup>62</sup> <http://www.earthworksaction.org/aircontaminants.cfm>
- <sup>63</sup> <http://www.earthworksaction.org/airpollutionsources.cfm#VEHICLES>
- <sup>64</sup> <http://un-naturalgas.org/weblog/2009/09/782/>
- <sup>65</sup> Revkin, A. and Krauss, C. October 14, 2009. “Curbing Emissions by Sealing Gas Leaks.” *New York Times*.  
<http://www.nytimes.com/2009/10/15/business/energy-environment/15degrees.html>
- <sup>66</sup> For numerous references on ozone and oil and gas drilling, see the June 2008 “Citizen Petition to Designate the Sublette County Area of Wyoming as Nonattainment for the 8-hour Ozone National Ambient Air Quality Standard.” [http://www.wyomingoutdoorcouncil.org/html/what\\_we\\_do/air\\_quality/pdfs/Wyoming\\_Nonattainment\\_Petition.pdf](http://www.wyomingoutdoorcouncil.org/html/what_we_do/air_quality/pdfs/Wyoming_Nonattainment_Petition.pdf)
- <sup>67</sup> Maugh, T. H. March 12, 2009. “Low-level Ozone Exposure Found To Be Lethal Over Time.” *Los Angeles Times*. <http://articles.latimes.com/2009/mar/12/science/sci-ozone12>
- <sup>68</sup> <http://www.landandwater.org/airpollution.html#fnii>
- <sup>69</sup> Wyoming Outdoor Council. January 7, 2010. “Making the Air We Breathe Cleaner: EPA Proposes Stricter Smog Rules.” <http://wyomingoutdoorcouncil.org/blog/?p=370>
- <sup>70</sup> [http://wyomingoutdoorcouncil.org/html/what\\_we\\_do/air\\_quality/large-scale\\_natural\\_gas\\_projects.shtml](http://wyomingoutdoorcouncil.org/html/what_we_do/air_quality/large-scale_natural_gas_projects.shtml) Scroll down to “Ozone in Pinedale.”
- <sup>71</sup> U.S. Department of the Interior Bureau of Land Management. December 2008. “Proposed Resource Management Plan Amendment and Final Environmental Impact Statement for Federal Fluid Minerals Leasing and Development in Sierra and Otero Counties, Vol. I.” (See Sections 3.10 and 4.2.1.7.)  
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- <sup>72</sup> <http://earthworksaction.org/noiseresources.cfm#OILGASNOISE>
- <sup>73</sup> <http://earthworksaction.org/noiseresources.cfm#OILGASNOISE>
- <sup>74</sup> Tillman, C. September 26, 2009. “The Results are In for the DISH, TX Air Study.”  
<http://baddish.blogspot.com/2009/09/results-are-in-for-dish-tx-air-study.html>
- <sup>75</sup> Wolf Eagle Environmental Engineers and Consultants. September 15, 2009. “Town of DISH, Texas Ambient Air Monitoring Analysis Final Report.” [http://www.townofdish.com/objects/DISH\\_-\\_final\\_report\\_revised.pdf](http://www.townofdish.com/objects/DISH_-_final_report_revised.pdf)
- <sup>76</sup> [http://earthworksaction.org/PR\\_DISH\\_HealthSurveyRelease.cfm](http://earthworksaction.org/PR_DISH_HealthSurveyRelease.cfm)
- <sup>77</sup> The history and extent of exemptions are discussed at:  
<http://www.ewg.org/reports/Free-Pass-for-Oil-and-Gas/Oil-and-Gas-Industry-Exemptions>
- <sup>78</sup> U.S. EPA. “Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations.” EPA Publication. (See particularly p. 8)  
<http://www.epa.gov/waste/nonhaz/industrial/special/oil/oil-gas.pdf>
- <sup>79</sup> <http://nywellwatch.org/2009/11/24/lawyers-description-of-local-laws-v-decs-power/>
- <sup>80</sup> [http://www.dec.ny.gov/docs/materials\\_minerals\\_pdf/08leasingrp.pdf](http://www.dec.ny.gov/docs/materials_minerals_pdf/08leasingrp.pdf) (see page 3)
- <sup>81</sup> Letter from Alexander Grannis, DEC Commissioner, to Assemblyman William Magee. (See p. 29.)  
[http://www.tcgasmap.org/media/Michelle\\_Bamberger\\_Comments\\_on\\_Draft\\_SGEIS.pdf](http://www.tcgasmap.org/media/Michelle_Bamberger_Comments_on_Draft_SGEIS.pdf)
- <sup>82</sup> <http://www.dec.ny.gov/energy/36159.html>
- <sup>83</sup> Water Law Clinic, Cornell Law School. “Additional Tasks Imposed on DEC Staff in Chapter 7 of the DSGEIS, By Section: 187 New Tasks For the DEC.” [http://www.tcgasmap.org/media/Cornell\\_Law\\_School\\_Water\\_Law\\_Clinic\\_SGEIS\\_Evaluation;\\_187\\_New\\_Tasks\\_for\\_DEC.pdf](http://www.tcgasmap.org/media/Cornell_Law_School_Water_Law_Clinic_SGEIS_Evaluation;_187_New_Tasks_for_DEC.pdf)
- <sup>84</sup> <http://www.tcgasmap.org>
- <sup>85</sup> Officer in the Residential Lending Division, Tompkins Trust Company, *personal communication*.

- <sup>86</sup> Mathewson, G.W. Esq. December 21, 2009. "Response to DSGEIS." Property values are discussed in Point #1. [http://www.tcgasmap.org/media/George Mathewson Comments on Draft SGEIS.pdf](http://www.tcgasmap.org/media/George%20Mathewson%20Comments%20on%20Draft%20SGEIS.pdf).
- <sup>87</sup> U.S. Department of Housing and Urban Development Handbook 4150.2: *Valuation Analysis for Single Family One- to Four- Unit Dwellings* <http://www.hud.gov/offices/adm/hudclips/handbooks/hsg/4150.2/index.cfm>
- <sup>88</sup> Lebrun, Michael. October 15, 2009. Testimony before the Environmental Conservation Committee of the New York State Assembly. [http://www.tcgasmap.org/media/Michael Lebrun SGEIS Testimony for NYFSESS.pdf](http://www.tcgasmap.org/media/Michael%20Lebrun%20SGEIS%20Testimony%20for%20NYFSESS.pdf)
- <sup>89</sup> Tillman, C. June 28, 2009. "Is the Juice Worth the Squeeze?" [http://baddish.blogspot.com/2009\\_06\\_01\\_archive.html](http://baddish.blogspot.com/2009_06_01_archive.html)
- <sup>90</sup> Federman, A. November 24, 2009. "Poisoning Dimock: Lawsuit Challenges Cabot Oil's Drilling Practices in the Marcellus Shale." *Counterpunch*. <http://www.counterpunch.org/federman11242009.html>
- <sup>91</sup> See explanation of pollution coverage in New York at: New York State Insurance Department, Office of General Counsel, Opinion dated October 22, 2001. <http://www.ins.state.ny.us/ogco2001/rg110221.htm>
- <sup>92</sup> <http://www.communityscience.org/gaswells.html>
- <sup>93</sup> NYSDEC web page on compulsory integration: <http://www.dec.ny.gov/energy/1590.html>
- <sup>94</sup> For a discussion of compulsory integration, scroll down to "Eminent Domain" in the following link: [http://www.un-naturalgas.org/hydraulic\\_fracturing\\_a-z.htm#eminent\\_domain](http://www.un-naturalgas.org/hydraulic_fracturing_a-z.htm#eminent_domain)
- <sup>95</sup> High-volume hydraulic fracturing (HVHF) of one well one time requires about 1,540 tanker truckloads of water and waste, assuming 5.6 million gallons of water are used, truck capacity is 5,460 gallons, and half of the fracking fluid comes back out. This estimate of tanker truck size is based on road sizes and conditions in the Southern Tier of NY. Trucks could be somewhat larger or smaller, affecting the number of trips. 220 to 364 more trips are needed to bring in equipment, materials, and employees (see Endnote 96). So, assume 1,760 to 1,904 trips to build, drill, and HVHF one well. Truck traffic continues at a lower rate during production, as toxic produced water must continually be hauled away.
- <sup>96</sup> Moss, K. "Potential Development of the Natural Gas Resources in the Marcellus Shale." National Park Service Geologic Resources Division. [http://www.tcgasmap.org/media/National Park Service Potential Development of Marcellus Shale.pdf](http://www.tcgasmap.org/media/National%20Park%20Service%20Potential%20Development%20of%20Marcellus%20Shale.pdf)
- <sup>97</sup> Goldstein, J. (Lebanon Town Supervisor). July 22, 2009. Letter to the Editor in *The Madison County Courier*. <http://www.madisoncountycourier.com/county-events/lebanon-supervisor-comments-on-recent-natural-gas-article-3135/>
- <sup>98</sup> Smith-Heavenrich, S. September 4, 2009. "Tioga County EMS and Fire Prepare for Gas Drilling." *Broader View Weekly*. [http://www.tiogagaslease.org/images/BVW\\_09\\_04\\_09.pdf](http://www.tiogagaslease.org/images/BVW_09_04_09.pdf)
- <sup>99</sup> Long, M. J. "What Local Governments Can Do To Minimize the Negative Impacts of Gas Drilling." [http://www.tcgasmap.org/media/What Local Governments Can Do--by Mary Jo Long.pdf](http://www.tcgasmap.org/media/What%20Local%20Governments%20Can%20Do--by%20Mary%20Jo%20Long.pdf)
- <sup>100</sup> See, for example, this chart by John Schwartz comparing revenue from potential Marcellus shale royalties to revenue from existing Upstate New York businesses: [http://www.tcgasmap.org/media/Marcellus Royalties Compared to Other Income.pdf](http://www.tcgasmap.org/media/Marcellus%20Royalties%20Compared%20to%20Other%20Income.pdf)
- <sup>101</sup> Headwaters Economics. 2009. "Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-focusing Counties Benefiting?" [http://www.headwaterseconomics.org/energy/HeadwatersEconomics\\_EnergyFocusing.pdf](http://www.headwaterseconomics.org/energy/HeadwatersEconomics_EnergyFocusing.pdf)
- <sup>102</sup> Freudenburg, W.R. and Wilson, L.J. 2002. "Mining the Data: Analyzing the Economic Implications of Mining for Nonmetropolitan Regions," *Sociological Inquiry*, Vol. 72, No. 4, Fall 2002, pp. 549-575.
- <sup>103</sup> Ellen Harrison, *personal communication*.
- <sup>104</sup> Jacquet, J. 2009. "Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities." NERC RD Rural Development Paper No. 43. <http://nercrd.psu.edu/Publications/rdpapers/rdp43.pdf>
- <sup>105</sup> Howarth, R. April 1, 2010. *Preliminary Assessment of the Greenhouse Gas Emissions from Natural Gas obtained by Hydraulic Fracturing*. [http://tcgasmap.org/media/Howarth Shale GHG Emissions 4-1-10.pdf](http://tcgasmap.org/media/Howarth%20Shale%20GHG%20Emissions%204-1-10.pdf)

- <sup>106</sup> A leak rate of 1.5% is reported in Harrison, Matthew R. et al. 1997. *U.S. EPA Project Summary: Methane Emissions in the Natural Gas Industry*. <http://p2pays.net/ref/07/06348.pdf>. As Revkin reported in the *New York Times*,<sup>107</sup> however, the EPA has recently concluded that one component of methane leakage (routine operations at gas wells) is 108 billion cubic feet (bcf) per year, not 9 bcf as is used in the original report. Incorporating this revised amount yields a leakage rate of 2%. (Note that Revkin reports that both government and industry officials admit that the leakage rate is likely higher than 2%.)
- <sup>107</sup> Reported by Revkin, A. and Krauss, C. October 14, 2009. “Curbing Emissions by Sealing Gas Leaks.” *New York Times*. <http://www.nytimes.com/2009/10/15/business/energy-environment/15degrees.html>
- <sup>108</sup> Lovelock, J. 2007. *Revenge of Gaia*. Basic Books. (See pp. 74–76.)
- <sup>109</sup> Intergovernmental Panel on Climate Change. 2007. *IPCC Fourth Assessment Report: Climate Change 2007*. Table 2.14. [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14)
- <sup>110</sup> Energy Information Administration (EIA). See data at: [http://tonto.eia.doe.gov/dnav/pet/pet\\_cons\\_psup\\_dc\\_nus\\_mbbl\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_a.htm) and [http://tonto.eia.doe.gov/dnav/ng/ng\\_cons\\_sum\\_dcu\\_nus\\_a.htm](http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm)
- <sup>111</sup> Krueger, Alan B. October 15, 2009. Remarks at *American Tax Policy Institute Conference*, Washington, DC. <http://www.ustreas.gov/offices/economic-policy/AK-ATPI-1015.pdf>
- <sup>112</sup> Berman, A. November 5, 2009. “Facts are Stubborn Things.” <http://www.aspousa.org/index.php/2009/11/facts-are-stubborn-things-arthur-e-berman-november-2009/>
- <sup>113</sup> Berman, A. August 10, 2009. “Lessons from the Barnett Shale Suggest Caution in Other Shale Plays.” <http://www.aspousa.org/index.php/2009/08/lessons-from-the-barnett-shale-suggest-caution-in-other-shale-plays/>
- <sup>114</sup> This calculation uses Terry Engelder’s estimates for production from New York counties (see Endnote 7), and the Chesapeake *pro forma* decline curve published in that article, and assumes development of the Marcellus Shale fairway before less productive regions are developed. Note that Engelder’s estimate requires that 70% of the available land area be drilled at a well density of 8 wells per square mile.
- <sup>115</sup> 2008 EIA data: see [http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1\\_9.pdf](http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1_9.pdf).
- <sup>116</sup> For a brief review of the history leading to the amendment of ECL §23–0303, see: <http://nywellwatch.org/2009/11/24/lawyers-description-of-local-laws-v-decs-power/>
- <sup>117</sup> For a review of case law relating to municipal home rule, see: [http://www.woh.com/img/newsletter/newsletter\\_4827464625.pdf](http://www.woh.com/img/newsletter/newsletter_4827464625.pdf)
- <sup>118</sup> Long, M. J. “What Local Governments Can Do to Minimize the Negative Impacts of Gas Drilling.” [http://www.tcgasmap.org/media/What Local Governments Can Do--by Mary Jo Long.pdf](http://www.tcgasmap.org/media/What%20Local%20Governments%20Can%20Do--by%20Mary%20Jo%20Long.pdf)
- <sup>119</sup> Rea, K. S. March 30, 2009. “A Legal and Practical Guide to Protecting Your Citizens and the Environment in the Face of Marcellus Shale Natural Gas Drilling.” <http://www.shaleshock.org/wp-content/uploads/2009/04/representation.pdf>
- <sup>120</sup> Southern Tier East Regional Planning Development Board. “Observations Concerning the Role of Local Governments in Relation to Natural Gas Exploration and Production in the Marcellus Shale in the Southern Tier East Region of New York State.” Technical Paper # 08–07. [http://www.catskillcitizens.org/Draft - Observations on Gas Production on marcellus shale.pdf](http://www.catskillcitizens.org/Draft_-_Observations_on_Gas_Production_on_marcellus_shale.pdf)
- <sup>121</sup> For the text and status of the House bill, see <http://www.govtrack.us/congress/bill.xpd?bill=h111-2766>