Hydrofracking: The Need for Responsible Gas Drilling Regulation and the Role of Natural Gas

A White Paper by Energy Vision

Summary

The escalating controversy in recent years regarding the impact of the natural gas drilling technique known as hydrofracking has raised important public concerns that must be addressed. These range from the toxic chemicals used and their impact on the environmental and human health to gas leaks, waste management, and the footprint of hydrofracking operations on the land. But the drawn out debate is turning public opinion against the fuel itself - the most abundant and cleanest fossil fuel resource in the US today.[1] Natural gas is the only fuel that can make a major dent in this country's dangerous reliance on foreign oil and that can, in fact, put a major sector of transportation on the path to a fully sustainable fuel: the renewable form of natural gas made from waste. What needs to be done in this situation? A look at the facts has led Energy Vision to the conclusions summarized here and discussed on the pages that follow:

1. The most prudent approach to hydrofracking operations would be to follow the priorities adopted two decades ago by Congress and the US Environmental Protection Agency for best safeguarding citizens and the environment from threats of toxic contamination. These priorities rank "preventive" action[2] as the leading strategy for avoiding risk and transparency[3] by industries generating toxic wastes as the principle strategy enabling government and citizens to evaluate industry practices. Applying these priorities, we conclude that no new permits should be approved for hydrofracking until at least these four conditions are met:

- There is complete transparency from the drilling industry regarding the specific chemicals and amounts used and produced at each site
- There is full reporting on the quantity and content of wastes generated, their related emissions and disposition
- The EPA has conducted and publicly released its analysis of this technology's impact on water and air resources and public health, and
- EPA regulations based on state-of-the-art practice for gas drillers are in place

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[1] US natural gas reservoirs, although eventually depletable, hold enough supply to last for a century or more at current consumption rates, according to the Potential Gas Committee, a noted non-profit professional organization made up of public and private sector experts on natural gas.

[2] The Pollution Prevention Act of 1990

[3] The 1986 Emergency and Planning Community Right-to-know Act (Title III)

2. Rapid regulation of the hydrofracking industry must be a top national priority since it will determine where and how the country's cleanest and most abundant fuel can be safely extracted without unacceptable risks to US water resources, air quality, and public health. In some areas, such as those containing major watersheds, the threats posed by hydrofracking may lead to rejection of this drilling option altogether, resulting from EPA regulations, state requirements, or local grassroots or environmental action.

3. While assessment of hydrofracking and development of industry regulations could take from months to years, there is sufficient latitude, given already developed natural gas supplies and gas deposits that can be extracted without the use of hydrofracking, to dedicate a portion of these to accomplishing what no other fuel can accomplish at present as rapidly – slash US oil dependence significantly – a dependence that is putting our national security, economic strength and public health at risk and contributing to climate change. Just 7% of current natural gas use (2009) could power all the buses and trucks (6.7 million) serving cities and towns across the US with routes taking them 50 miles or less from home base.[4] Since these vehicles account for more than 1/3 of the diesel fuel consumed by trucks and buses, this fuel shift would eliminate 13.6 billion[5] out of the 38 billion gallons of diesel used a year and do so where the clean air gains will mean most.

4. Of special importance, building refueling infrastructure enabling vehicles to use conventional natural gas (the most immediate option) in urban areas will be a major market driver for communities and companies to begin producing an even better gas fuel that can use this fuel distribution system – a gas made from wastes, called renewable natural gas: "RNG" or "biomethane." It is produced by collecting and refining the biogases created wherever organic materials are breaking down (landfills, sewage treatment plants, farm and dairy operations, etc). RNG is in commercial use in Europe but is just arriving in the US. It requires no drilling, is renewable, carbon-negative and virtually pollution free – the first truly sustainable fuel. It can be blended with or replace conventional fossil gas.

5. Legislative action is needed on two fronts. Even as federal and state authorities regulate hydrofracking, they must also put in place economic incentives creating a level playing field for producers of RNG as well as for providers of gas refueling infrastructure and of natural gas vehicles. These will empower cities and communities to end their reliance on oil and vest their future in fleets powered by conventional natural gas as they begin planning to turn their expensive wastes into a long term sustainable fuels solution.
These incentives will ultimately enable long haul fleets to do the same.

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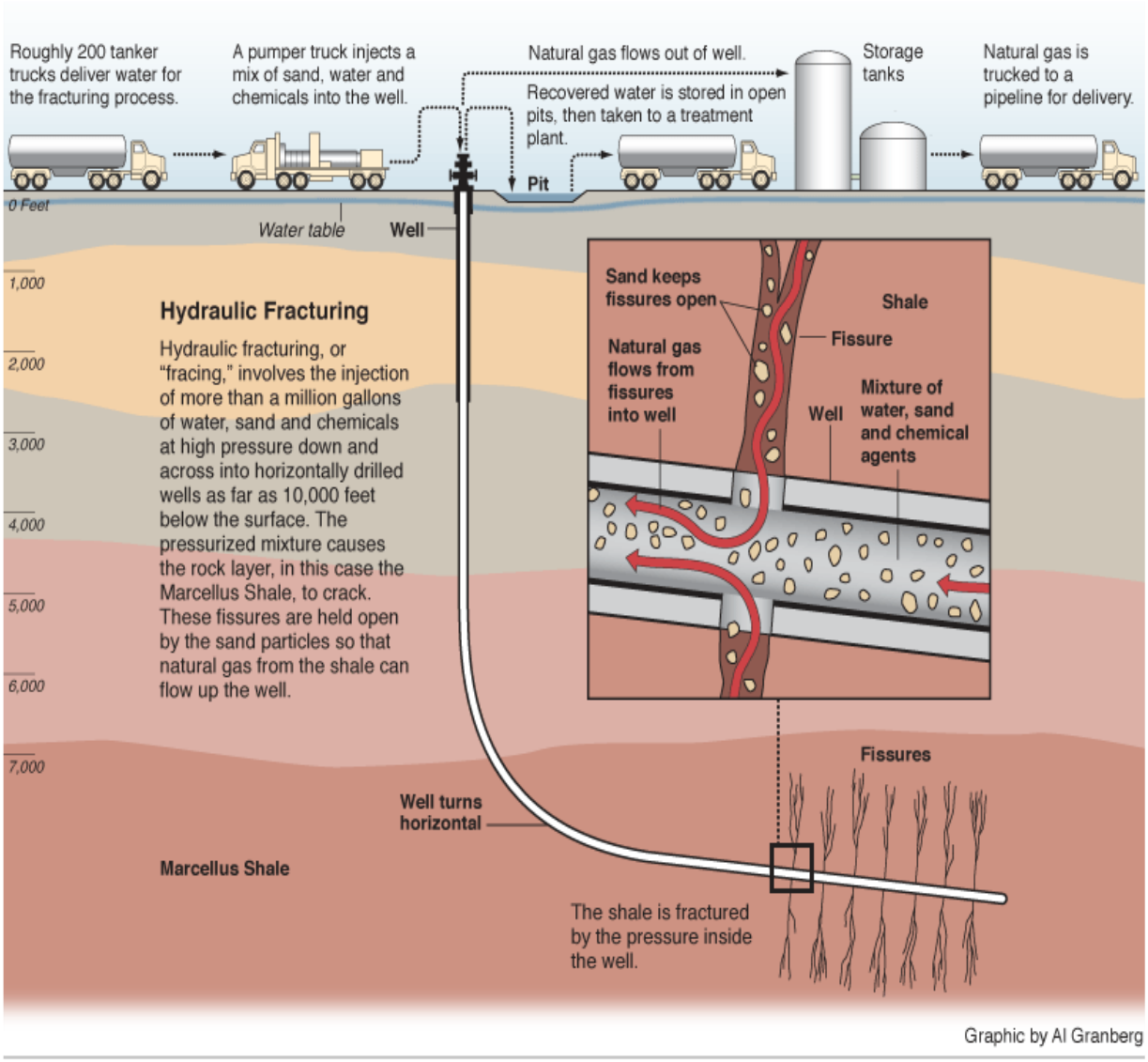
[4] According to the Vehicle Inventory and Use Survey (VIUS) conducted by the U.S. Census Bureau in 2002, 67% of medium and heavy trucks travel 50 miles or less from home base and travel 36% of all vehicle miles traveled for the sector. Since no survey has been conducted since 2002, EV is using this proportion for its analysis.

[5] The basic unit conversions involved here are as follows: 1 diesel gallon =138,690 British thermal units (Btu), and 1 cubic foot (cf) natural gas = 1027 Btu. One-third of current diesel consumption of 38 billion gallons is 14.4 billion gallons. To convert this to cubic feet (cf) of gas, multiply 14.4 billion by 138,690, then divide the result by 1027. The answer is 1.9 trillion cf of natural gas, or 7% of the total 2009 natural gas production and withdrawals (26.1 trillion cf). U.S. Energy Information Administration. http://www.eia.gov/dnav/ng/hist/n9010us2A.htm.

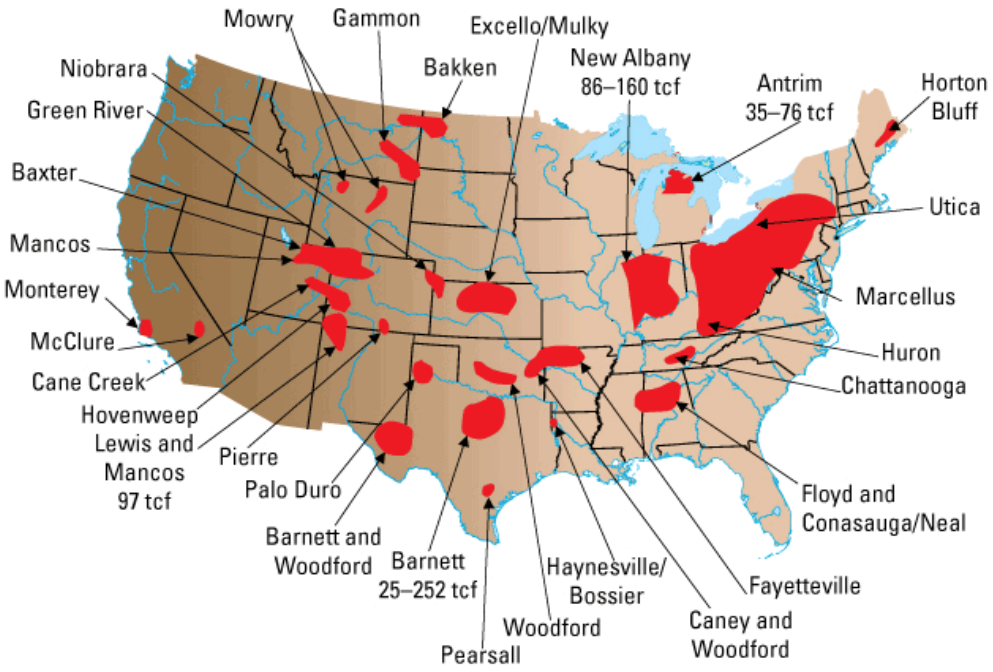
“HYDROFRACKING”: WHAT IS IT?

High-volume hydraulic fracturing, or “Hydrofracking,” is a method of extracting natural gas from shale rock formations buried up to 10,000 feet under 30 or more states. It involves blasting these formations horizontally with water, sand and chemicals and creating fissures so the gas is released.



Where are these shale formations, and how much natural gas do they contain?

The map below shows the distribution of the major natural gas-rich shale formations identified to date in the U.S.



The natural gas contained in these shale formations represents a huge storehouse of this country's cleanest fossil fuel. The Potential Gas Committee, a non-profit group of natural gas experts, forecasts that this resource base contains 1,836 Tcf of gas. This, plus the proven reserves (238 Tcf) identified by the US Department of Energy in 2007, mean that the US has enough natural gas to last at current rates of use for 118 years.

Shale gas extraction began in the early 1990s when the technology for fracturing the deeply buried shale rock formations was refined and the rising price of fuels made this technology economically viable.

In the last 15 years, a frenzy of drilling has taken place in the Western states – involving tens of thousands of individual wells (for example, 30,000 in the State of Colorado alone). Millions of acres of land have been leased in 32 states by companies that are eager to get in on the "gas bonanza."

How does hydrofracking impact the environment?

"Hydrofracking" fluid, which is injected into shale formations, uses about one to two million gallons of water for a single "fracking," and a well may be fracked multiple times. So water resource depletion, if current practices persist, must be of concern as drilling expands, especially in parts of the water-short West.

In addition, more than 200 chemicals have been reported to be used in the hydrofracking fluid. While these make up just a fraction of the total materials in the fluid, they include recognized carcinogens (benzene, arsenic and polycyclic aromatics). Other substances are associated with endocrine disruption, damage to reproductive health, immune suppression, and genetic mutations.

In addition, when shale formations are blasted open, other toxic substances and radioactive materials are released. Confidential EPA research, reported in a March 2011 series in *The New York Times* series, has found these materials returned to the surface from the wells to be improperly disposed of by some wastewater treatment plants and concluded that the concentration of radioactive material might be impossible for natural waterways to dilute. This could pose a continuing health threat to humans and to wildlife drinking or exposed to this water. Given the rapidly expanding use of hydrofracking, more substantial documentation of actual water contamination is critical.

About 60% of the hydrofracking fluid is usually recovered after drilling. It is stored on site in evaporation pits and may then be trucked offsite for use in another fracking operation or for treatment and disposal in surface waters or underground reservoirs. Forty percent or more of the fluid remains underground. Can these fluids migrate underground? Have they done so? And, if so, where? According to *The New York Times* reporting, some drilling

companies are now recycling the recovered fluid. Unfortunately, recycling wastewater results in a highly concentrated sludge of chemicals. Legislation requiring a tracking system for disposal of this sludge failed, although it is known that some wastewater is disposed of in wastewater treatment plants and some is sold to municipalities to clear ice and snow off roads (recycled wastewater has a very high salt content). US EPA research found that about 50 million gallons of wastewater was unaccounted for.

Are water pollution and depletion the only issues?

No. There are more. Air pollution is an issue related to site operations, evaporation pits, and to the emissions of the hundreds of heavy duty diesel trucks coming and going carrying materials, water and wastes.
Large areas of cleared land and many miles of roadways scar the landscape, and water seeping into the ground is not purified as it would be if it were to pass through vegetated areas. Drilling operations also involve lights 24 hours a day. Noise pollution is another issue – from the initial month of drilling the well to the continuous noise generated by operation of compressor stations.

Is the water and air pollution affecting public health?

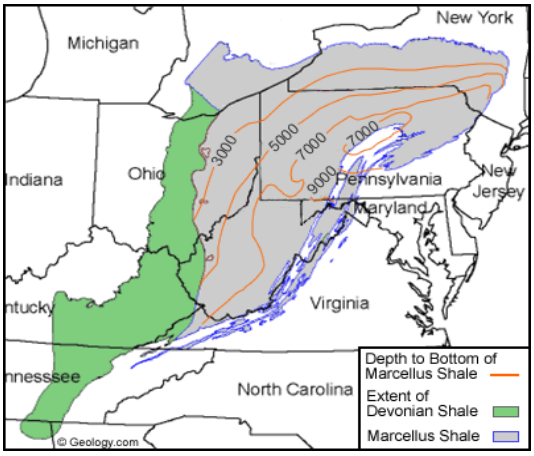
It seems so but the extent is not clear. From areas in the West and in Pennsylvania where hydrofracking operations are going on have come dozens of reports of water contamination, of offensive odors, and of health impacts on citizens. These reports and the health in other communities deserve in-depth study.

What is known is that chemicals that could endanger public health are used in hydrofracking fluid. Research by Dr. Theo Colborn, a leading expert on endocrine-disrupting chemicals, and testimony by the Natural Resources Defense Council, by Environmental Advocates of New York, and by Riverkeeper contain discussion of these chemicals. But more thorough government documentation is needed of the quantities of these chemicals used as well as or of related impacts on the health of humans and wildlife.

Why has there been such vehement opposition to hydrofracking in the Marcellus Shale in NYS?

The Marcellus Shale is one of the largest shale gas formations in the US. It is estimated to contain between 168 and 516 trillion cubic feet of natural gas within its entire formation. It runs under much of New York State, Pennsylvania and all the way down to Tennessee.

With so much water and so many toxic chemicals used in hydrofracking, many NYC leaders and environmentalists fear contamination of the watershed that supplies pure unfiltered drinking water to more than 9 million residents of NYC and neighboring counties –half the population of NY State.



Concern extends elsewhere in the State. For example, local and environmental groups in the Finger Lakes region, the Susquehanna watershed, and other regions of the Southern Tier and Western New York, have voiced opposition to hydrofracking and to having fracking wastes containing radioactive materials disposed of in local landfills.

After the New York Department of Environmental Conservation (DEC) hearings, former governor, David Paterson placed a moratorium on horizontal hydrofracking near or in watersheds, and announced that the DEC is drafting a new general Environmental Impact Statement that will be used in evaluating new hydrofracking applications in the State. The EIS will be published this summer. This EIS, however, will not cover applications in the NYC watershed. For these, another EIS will be prepared. Until they are complete, the DEC will not process any applications for new drilling.

SPW are shown in grey. Image provided by the Delaware Basin Commission

Even as the DEC considers the permitting process, a number of major environmental organizations, including the Natural Resources Defense Council, Environmental Advocates of New

York, Earth Justice, Riverkeeper, and Catskill Mountainkeeper, are weighing steps to ensure protection of New York State's watersheds. The Delaware River Basin Commission has produced new guidelines that require companies to get approval from the Commission before drilling in Special Protected Waters (SPW). These guidelines will protect the runoff areas of the Delaware River, which run through New York and New Jersey.

Why is current regulation of hydrofracking insufficient?

There is little of it. This is because in 2005, when the energy act was passed, it contained what has been called the "Halliburton Loophole." With this loophole, the 2005 energy act allowed hydrofracking fluid content to be classified as a trade secret. (So while the Pennsylvania State Government has been able to obtain and post a general list of chemicals used in hydrofracking fluid, the amounts of the chemicals used has not been made available.) Hydrofracking practices were also exempted from regulation under the US Safe Drinking Water Act and other statutes.

However, the US Environmental Protection Agency, in response to growing public and Congressional concern, launched a study in March 2010 of the impacts of hydrofracking, which could lead to regulation. The limitations of this study have to do with the funding provided to the agency for this work (less than $2 million while the EPA Administrator has indicated that as much as $30 million may be needed) and the fact that the scope of work does not cover public health. How can this be adequate to address public concerns?

Even before this, in November of 2009, a piece of legislation was introduced into the Senate and House called the "Fracturing Responsibility and Awareness of Chemicals Act," or "FRAC Act." This would give EPA back the authority to regulate hydrofracking under the provisions of the Safe Drinking Water Act. It would also require companies conducting hydrofracking operations to publish a detailed list of the chemicals in their fracturing fluid. While, in June 2009 the bill was referred to the Committee on Environment and Public Works and died, it was reintroduced in 2011.

Can EPA regulation alone solve the problems?

Not totally! States will weigh in too. Further, the drilling industry itself must step up to the plate. Regulations, while important, may take years to draft and implement and then be tied up in court. Addressing the hydrofracking issues thoroughly requires that the industry be transparent about chemicals used and what is in its wastes as well as bend its maximum efforts to improve state-of-the-art practices so they can bring their product to market while minimizing the risks of water depletion, of water and air pollution and related health impacts, and minimizing the disruption of landscapes and vegetation that these operations now cause. Industry's know-how could go far in addressing many questions including:

- How to modify fracking fluid to reduce or eliminate the use of toxic chemicals and cut their water consumption.
- How to tighten operations so that spills of hydrofracking fluid or fluids coming from the shale formations and leaks from pipes underground are eliminated.
- How to minimize the escape of methane or toxic fumes from operations, to prevent gas releases from evaporation pits, and maximally reduce emissions from diesel trucks and other vehicles.
- How to keep land and vegetation resources intact for wildlife and humans.
- How to safely dispose of wastewater, radioactive tailings, and other waste products associated with hydrofracking so that their contaminants do not enter the environment.
- How to tighten the gas pipeline system to minimize the escape of climate-changing greenhouse gases.

As Hydrofracking issues and solutions are studied – What to do at present?

Follow EPA's stated priority: pollution prevention first

Given the many issues that need study and resolution related to hydrofracking technology, the most prudent approach in line with the top priority given to

"preventive" action[6] and industry transparency[7] by Congress and the US EPA, would be to approve no new permits for use of this technology at least until:

1) There is transparency from the drilling industry regarding the specific chemicals and amounts used at each fracking site and regarding the content of the "produce water" that comes out of a well that was contained in the shale formations - also a stream with radioactive and other toxic components;

2) There is full reporting on all materials and wastes and their disposition;

3) The findings of EPA's analysis of this technology's impacts are released; and

4) EPA regulations for this industry based on the state of the art are in place.

At that point, it will be much clearer where hydrofracking operations can be conducted without unacceptable impacts on water resources, air quality and public health. In some areas, such as those containing major watersheds, the threats may mean a rejection of this drilling option altogether, resulting from EPA regulations, state requirements, or local grassroots or environmental action.

Use already developed natural gas supplies strategically to put US transportation on the path to sustainability

Even if no further hydrofracking permits were approved until industry regulations were established, this country's already developed natural gas supplies and additional gas that can be extracted without use of hydrofracking might well be sufficient to meet an immediate critical US need – making significant progress in weaning our transportation sector (where 67% of all petroleum consumed in the US goes) from its dangerous reliance on foreign oil and putting it on the path to use of sustainable fuel.

Natural gas has become a favorite for electric power generation[8], since, being 80% hydrogen, it makes for clean plants. But there are many other clean

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[6] The Pollution Prevention Act of 1990

[7] The Planning and Emergency Community Right-to-Know Act (Title III)

[8] Major areas of consumption of natural gas in 2009: 30% electric power; 27% industrial; 21% residential; 14% industrial; 1% transportation (US Energy Information Administration)

options for power generation – demand side management, solar, wind, hydropower, geothermal etc. Natural gas, however, is the one and only available alternative for transportation that can play a substantial role today in slashing reliance on petroleum-derived fuels.

While important explorations are underway with regard to electric vehicle use and smart grids, natural gas is a fully commercial option now for this country and especially valuable for use in the 10 million medium and heavy duty trucks and buses. While these vehicles make up only 4% of all vehicles (10 million out of 260 million) they consume 23% of all on-road fuel (15% of total US oil consumption). Displacing diesel fuel in the bus and truck sector would stem the flow of over $100 million dollars a day out of this country to foreign oil suppliers who control both oil supplies and costs.

But just 7% of already developed natural gas supplies (2009) would be sufficient to power the 6.7 million buses and trucks that service cities and towns in the country that have routes taking them 50 miles or less from home base[9]. The distance that vehicles travel is important since bus and truck fleets with fixed routes of about this distance travel back to their home bases at night and can take advantage of a single refueling facility. Such fleets account for more than one-third of the total fuel (mainly diesel) consumed by trucks and buses. Shifting them to natural gas would eliminate approximately 13.6 billion[10] out of the 38 billion gallons of diesel used a year[11].

And use of natural gas fuel in urban bus and truck fleets most directly addresses the urban air pollution (at street level) that now causes more than 150 million Americans to live in jurisdictions where air quality violates national air quality public health standards, causing a range of respiratory and cardio-vascular diseases.

Of perhaps greatest importance, putting in place refueling infrastructure for a gas rather than a liquid fuel to serve transportation also creates a powerful

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[9] According to the Vehicle Inventory and Use Survey (VIUS) conducted by the U.S. Census Bureau in 2002, 67% of medium and heavy trucks travel 50 miles or less from home base and travel 36% of all vehicle miles traveled for the sector. Since no survey has been conducted since 2002, EV is using this proportion for its analysis.

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[11] Long haul truck fleets that carry products and goods (worth close to $10 trillion and equal to about two thirds of the nation's annual Gross Domestic Product (GDP), critical to this country's economy, use about 2/3rds of all diesel fuel and so are also an important fuel shifting target.

market driver for communities and companies to begin producing an even better gas fuel that can take advantage of that infrastructure, called "Renewable Natural Gas" (RNG) or "biomethane."

Renewable Natural Gas is already in growing use in Europe, powering hundreds of buses and trucks in Sweden, Germany, France, Switzerland, and Spain. It is made by collecting and refining the biogases generated wherever organic wastes are breaking down: in landfills, at sewage treatment plants, or in agricultural and dairy settings. Once the gases and CO2 are extracted from organic wastes, the remaining materials constitute a valuable soil amendment.

RNG production is just beginning in the US. One major project at the Waste Management-owned Altamont Landfill in California is extracting and refining gases and using them to fuel 400 refuse trucks at the site (or with LNG trucked to refueling locations), which are serving 20 communities. The feedstocks for RNG production are in huge supply across the country – the most immediate areas of opportunity being the more than 1,500 large EPA-monitored landfills, the 16,500 sewage treatment plants, and the thousands of farm and dairy operations. Taking advantage of these can create hundreds of thousands of jobs in a whole new "green fuel" industry[12].

Industry's entrepreneurial energies focused on producing RNG to replace traditional "fossil gas" will both reduce the need for drilling and turn this country's garbage and sewage disposal problems into a clean fuel solution with economic benefits for municipalities dealing with spiraling waste costs.

Regulations and incentives: the tools of change

While federal and state regulations are vital for assuring safe environmental practices in the hydrofracking industry, federal and state incentives are just as vital for extricating this country from its petroleum-fuel addiction.

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[12] Energy Vision and Rutgers University's EcoComplex launched in December of 2010 a Work Group in New Jersey, consisting of 30 government and business leaders to assess the specific feedstocks for biomethane production and the technologies, local community action steps and state policies and programs that can jump start this industry in the State. See www. energy-vision.org. The steps already taken in New Jersey that are shifting the first communities to use of conventional natural gas refuse trucks and buses have required building the gas refueling infrastructure that will be able to distribute this new sustainable fuel.

The incentives put in place under the 2005 energy policy and transportation acts created important drivers promoting growth of the natural gas vehicle industry by covering 80% of the incremental costs of purchasing natural gas or other alternative fuel vehicles, for building natural gas refueling infrastructure, and making alternative fuels cheaper than petroleum-based fuels.

But at the end of 2010, the incentive related to the incremental cost of buying alternative fuel vehicles was not renewed by Congress, and incentives for building refueling infrastructure and creating a price advantage for natural gas and other alternative fuels were kept in place in the short run.

New legislation, expected to be introduced in the spring of 2011, will aim at reinstating a full roster of incentives to accelerate the pace of change. Assuring such incentives for at least a ten year period would be preferable if companies as well as communities are to feel safe investing in new technology and new fuels.

Federal economic incentives need to be geared to give companies and communities a level playing field for selling and purchasing natural gas and other alternative fuel vehicles, for expanding natural gas refueling infrastructure, for sustaining a cheaper price for petroleum-free fuels, and for promoting the growth of the waste-to-fuels industry, speeding the transition toward a sustainable fuels future. State incentives can increase the momentum.

The original research for this paper was conducted by EV intern, Caroline Herman, a Freshman at Bryn Mawr College, Bryn Mawr, PA, and supplemented by EV intern, Leila Saad.

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