

# Industrial Unsustainability

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## Abstract

The development of unconventional gas exploration in the USA, in particular shale gas, caused a revolution in the American and the global gas markets. The regional-wide use of unconventional gas resources could stabilize the natural gas demand and the energy supply security of European and Asian countries. But traditionally, almost all gas contracts in Europe and Asia are linked to oil because of the demand for stable, long-term contracts. Furthermore, in many Asian countries, large state-owned enterprises dominate their national gas markets, leading to little competition and incentives to reduce gas prices. In Europe, the expansion of unconventional gas is facing grassroots opposition from environmental groups who are concerned about ground water safety, adequate waste water management, seismic events and greenhouse gas emissions. In this article, I will discuss the rapidly changing natural gas markets and the role and prospects of unconventional gas as well as its environmental impacts and unsustainability in industry level.

## Keywords

Hydro Fracking, Natural Gas, Industries, Unsustainability, Sustainable Industries

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## 1. Introduction

One of the reasons that we have been successful as a species on this planet is because of our remarkable ability to adapt our environment to suit our own needs. We humans are incredibly resourceful, and we have the capacity to engineer solutions to problems and challenges that we face, however there is a cost often an environmental cost—for this benefit. Some industrial practices that provide the means to expand our civilization—and our quality of life—are inherently detrimental to the environment. Industry can pollute air and water, produce waste, and consume natural resources, while at the same time providing valuable goods and services to an ever-growing population. Without industry, humankind would not have been able to flourish as they have.

Industry plays a critical role in technological innovations and research and development activities, which are crucial for the economic and social development of any country, as well as in the development, diffusion and transfer of environmentally sound technologies and management techniques, which constitute a key element of

sustainable development.

There is a mutually reinforcing relationship between social and industrial development, and industrialization has the potential to promote, directly and indirectly, a variety of social objectives such as employment creation, poverty eradication, gender equality, labor standards, and greater access to education and health care. In this regard, the overriding policy challenge is to promote the positive impacts while limiting or eliminating the negative impacts of industrial activities on social development.

As the world has become more industrialized, there have been increasing environmental pressures such as harmful emissions and waste, which have had global, regional or local impacts. These include, at the local level, urban air pollution, contamination of soils and rivers and land degradation; regionally, acid rain and water and coastal zone contamination; and globally, climate change, ozone layer depletion, loss of biodiversity, increased movement of hazardous waste and increased land-based marine pollution.

Under the current system, many economic and social gains are realized at the expense of environmental degradation. Raw natural resources are extracted and processed into goods, which allow for continued economic expansion. During the process, waste is created, air is polluted, and water is contaminated. As a direct result of our affluence, the ecological footprint of humans is increasing at the same rate as our population, and this footprint has already been thought to exceed the biological capacity of the planet. To reduce our ecological footprint, we could either halt our economic growth, which is an unreasonable concept to most, or we could adapt a more ecological and sustainable way of managing economic growth.

## 2. Hydro Fracking Unsustainable Industry

In the present scenario if see the example of very unsustainable industry which could become successful to fulfill the demand of growing population all over the world but it will need lots of modification and improvement in terms of environment, economic, social etc. to make it sustainable. The industry which is based on extracting the gas, known as Hydraulic fracturing, it is a process used in nine out of 10 natural gas wells in the United States, where millions of gallons of water, sand and chemicals are pumped underground to break apart the rock and release the gas. Scientists are worried that the chemicals used in fracturing may pose a threat either underground or when waste fluids are handled and sometimes spilled on the surface (*Hydraulic Fracturing* 101) [1].

On the other hand, the United States has experienced a boom in natural gas production due to recent technological innovations that have enabled natural gas to be produced from unconventional sources, such as shale. There has been much discussion about the costs and benefits of developing shale gas among scientists, policy makers, and the general public. The debate has typically revolved around potential gains in economics, employment, energy independence, and national security as well as potential harms to the environment, the climate, and public health. In the face of scientific uncertainty, national and international governments must make decisions on how to proceed. So far, the results have been varied, with some governments banning the process, others enacting moratorium until it is better understood, and others explicitly sanctioning shale gas development (U. Frank. September, 2013) [2].

Hydro fracking involves forcing a mix of water, sand and chemicals down a gas or oil well under extremely high pressure with the goal of cracking previously impermeable rock (typically shale) to create fractures that will allow trapped oil and/or gas deposits to flow to the surface. It is a process used in nine out of 10 natural gas wells in the United States. Scientists are worried that the chemicals used in fracturing may pose a threat either underground or when waste fluids are handled and sometimes spilled on the surface (Birgit C. Gordalla, Ulrich Ewers, Fritz H. Frimmel. December, 2013) [3].

However, some analysts expect that shale gas will greatly expand worldwide energy supply. A study by the Bakers Institute of public policy at rice university concluded that increased shale gas production in the US and Canada could help prevent Russia and Persian Gulf countries from dictating higher prices for the gas they export to European countries.

On the other hand, the environmental impact of hydraulic fracturing includes contamination of ground water, risks to air quality, noise pollution, migration of natural gas and Hydraulic fracturing chemicals to the surface and air, mishandling of waste, and related health issues. Hydraulic fracturing can cause potentially irreversible threats to health and safety. Cases of groundwater contamination have been documented. There is also evidence that it may cause earthquakes under some conditions. (*Report: rapidly expanding frac sand mining is hidden danger of fracking boom in US*, 2014) [4].

The economic advantages are extremely appealing, and have allowed multiple “in-laws” the opportunity to retire more comfortably, neighboring farmers to finally break even, and created an economic boom to Wyoming County that wouldn’t have ever occurred otherwise. I understand there are environmental concerns with this practice, but people are more drawn towards the mighty dollar.

While there appears to be some correlation between the well drilling operations and possible methane contamination, unfortunately not much well water testing was done before the wells were in place, making it that much more difficult to draw a complete connection. Many Pennsylvania residents are aware that certain drinking water contamination cases existed, but that no data could show what the water was like prior to drilling. They in fact didn’t believe that it was having the impact other landowners were claiming and that was why they made the decision to allow fracking. Without the adequate data, they chose to allow the drilling to commence so that they wouldn’t lose out on the financial opportunity.

As the Duke research study states, there are three possible mechanisms for fluid migration into shallow drinking-water aquifers to could correlate to increased methane concentrations near gas wells. First, is physical displacement of gas-rich deep solutions from the target formation or second, are the gas-well casings leaking. Third, the process of hydraulic fracturing generates new fractures or enlarges existing ones above the target shale formation, increasing the connectivity of the fracture system. Finally they state “Based on our groundwater results and the litigious nature of shale-gas extraction, we believe that long-term, coordinated sampling and monitoring of industry and private homeowners is needed.” Until further research is done, the actual cause cannot be pin-pointed. If property owners are educated on hydro fracking they should be aware of the concerns that come with the process, and then make their own decision. In this scenario, I think that it is important to allow landowners to decide what to do with their land, through their rights as the property owners and property rights that are associated with that (Debra Goldberg, ENN October 2, 2013) [5].

As the 2011 New York Times article reported, there seems to be much exaggeration about the long-term productivity of these wells. The company’s end is to state a higher profit, and their means is to overstate the productivity of wells. The consequences of this may lead to the drilling of unnecessary wells in depleted areas, as well as the consequence of misleading investors who believe their investment will lead to a long term financial gain, and misplaced subsidies that would result in less government funding and increased taxpayer burden. Being such a new technology, there doesn’t appear to be much scientific consensus on the longevity of natural gas wells in general, though insiders believe it is being overstated, while companies are getting away with these overestimates due to a large degree of uncertainty.

We conclude that greater stewardship, data, and—possibly—regulation are needed to ensure the sustainable future of shale-gas extraction and to improve public confidence in its use.” (Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing) leads me to believe that there is a concern about lack of regulations and lack of studies on long range methane in drinking water. What studies have been done have determine that the water is not contaminated by fracking.

The US government has stated many times that it would like to rely less on foreign oil. I believe that natural gas here in the US, an in particularly the hydro fracking is a way in which federal government and big oil companies see an avenue to accomplish this goal (M. Greg. October, 2014. *NPR*) [6].

It is a tough subject to think about sitting here at my computer miles away from Colorado, New York, Wyoming or Pennsylvania, but I would like to think that the oil companies would have the land owners and the surrounding citizens aware of the fracking and also take great measure to prevent leaks and over use of harsh chemicals. I would like to think drinking water is more important than oil, but I do drive a gas guzzling pickup. I like my house cool in the summer and warm in the winter.

We are all one in a flowing continuous circuit, “When a change occurs in one part of the circuit, many other parts must adjust themselves to it. Change does not necessarily obstruct or divert the flow of energy; evolution is a long series of self-induced changes, the net result of which has been to elaborate the flow mechanism and to lengthen the circuit. Evolutionary changes, however, are usually slow and local. Man’s invention of tools has enabled him to make changes of unprecedented violence, rapidity and scope”. With this being said, is the degradation of the land worth it? In my case no, the oil is deep in the land for a reason. The oil does not want to be captured and we are going through hoops and affecting so much just to capture it. Some of the obstacles that the oil companies are running through are: the ruptures in the soil are allowing methane to enter a landowner’s well, towns are having to ask the oil companies for money to repair the roads that the big rig trucks haul over excessively for transportation of materials, air is being comprised in addition to the water and roads, character of the

earth is being disrupted it which can possibly be linked to earthquakes and benzene products being released from the wells and the drilling companies trucking in bottled water for the workers, just to name a few.

During present era of modern development around the world, the need for the development of forms of life that are sustainable grows consistently in urgency Hydraulic fracturing is expanding rapidly in the United States and poses a little-understood threat to human health, the environment, and local economies, according to a major report issued today by the Civil Society Institute's Boston Action Research (BAR) and released in cooperation with Environmental Working Group (EWG) and Midwest Environmental Advocates (MEA).

By taking example of Wisconsin and Minnesota, which have a total of 164 active fracking sand facilities, and another 20 that have been proposed. Wisconsin alone is on track to extract 50 million tons of fracking sand a year—the equivalent of 9000 semi-truck loads a day and enough to fill the nation's second tallest building, the former Sears Towers in Chicago, 21 times a year.

Drilling companies are now discovering that the use of more fracking sand per well increases shale gas and oil yields. As a result, analysts estimate that fracking companies will require 95 billion pounds of fracking sand this year, an increase of almost 30 percent from 2013 and 50 percent above initial forecasts. Given the explosive growth in fracking nationwide, extraction could spread to several other states with untapped or largely untapped fracking sand deposits, including Illinois, Maine, Massachusetts, Michigan, Missouri, New York, North Carolina, South Carolina, Pennsylvania, Tennessee, Vermont and Virginia (C. Steven. September, 2012) [7].

Some analysts expect that shale gas will greatly expand worldwide energy supply. A study by the Bakers Institute of public policy at rice university concluded that increased shale gas production in the US and Canada could help prevent Russia and Persian Gulf countries from dictating higher prices for the gas they export to European countries.

As we see the consequences we realize, the environmental impact of hydraulic fracturing includes contamination of ground water, risks to air quality, noise pollution, migration of natural gas and Hydraulic fracturing chemicals to the surface and air, mishandling of waste, and related health issues. Hydraulic fracturing can cause potentially irreversible threats to health and safety. Cases of groundwater contamination have been documented. There is also evidence that it may cause earthquakes under some conditions. As all these reported in Wisconsin, where people got suffered from water issues, health issues, economic issues (Fracking. NPR) [8].

The study prepared in 2012 for the Directorate general for Environmental European commission identified ground and surface water contamination, large usage of water resources, air emissions, land taken out of usage, risk to biodiversity, noise impacts, and increased traffic as main cumulative risks caused by massive hydraulic fracturing for unconventional gas extraction. When changes occur in one part of the circuit, many parts must adjust themselves to it. It is showing harmful impact on health, wealth and well-being of everyone and the environment. We have to preserve all the three for our biotic community not just for our own sake but for the coming generations. However, some actions can radically alter the characteristic structure or functional processes of an ecosystem, such as eliminating important species with pesticides, introducing exotic species, destroying habitat, or dumping wastes into fresh water.

Scientists have found it difficult to determine whether hydraulic fracturing is responsible for these problems. In large part that's because the identities of the chemicals used in the fluids have been tightly held as trade secrets, so scientists don't know precisely what to look for when they sample polluted streams and taps. The lack of scientific certainty about hydraulic fracturing can be traced in part to the drilling industry's success in persuading Congress to leave regulation of the process to the states, which often lack manpower and funding to do complex studies of underground geology. As a consequence, regulations vary wildly across the country and many basic questions remain unanswered.

A Duke University study of Blacklick Creek (Pennsylvania) carried out over two years, took samples from the creek upstream and downstream of the discharge point of Josephine Brine Treatment Facility. Radium levels in the sediment at the discharge point are around 200 times the amount upstream of the facility. The radium levels are "above regulated levels" and present the "danger of slow bio-accumulation" eventually in fish. The Duke study "is the first to use isotope hydrology to connect the dots between shale gas waste, treatment sites and discharge into drinking water supplies." The study recommended "independent monitoring and regulation" in the United States due to perceived deficiencies in self-regulation. This shows the consequences of no regulation for Hydraulic fracturing .What is happening is the direct result of a lack of any regulation. If the Clean Water Act was applied in 2005 when the shale gas boom started this would have been prevented. In the UK, if shale gas is going to develop, it should not follow the American example and should impose environmental regulation to

prevent this kind of radioactive buildup.

There are two schools of thought regarding achieving industry sustainability: Industrial ecology and ecological modernization. The desired result of both industrial ecology and ecological modernization is to satisfy social, environmental, and economic goals simultaneously, in order to provide the best possible outcome for all three interests. Each school of thought has different ways in which they achieve their goals.

While traditional views of ecology deal with strictly environmental interactions, Industrial Ecology focuses on the potential interaction between industrial activities and their effect on the environment. Historically, industry has largely operated outside the confines of environmental responsibility and stewardship, often acting against environmental interests because of costs. Industrial ecology recognizes the need for a more symbiotic relationship between industry and environment, and provides technical solutions as to how that can be accomplished.

### 3. Industrial Ecology

The single most important thing that industry can do to increase their sustainability is to reduce the amount of energy used. The industrial sector of energy consumption is the largest end user of energy, consuming almost one-half of the world's total energy produced. In the United States, industries consume about 21% of the total energy produced, 85% of which comes from non-renewable resources—with a heavy reliance on fossil fuels. Reducing energy costs can be as simple as making small investments in more efficient technologies that will reduce energy use and costs, eventually paying themselves off. With rapidly increasing costs of energy the return on investment—or ROI—for energy upgrading, can be significant and rapid.

Energy Consumption remains one of the most fundamental issues facing human society. Hydraulic fracturing for the extraction of natural gas is a controversial technique in the Marcellus Shale Regions of the United States and elsewhere. It is controversial because it involves the usage of millions of gallons of water that is laced with hundreds of chemical contaminants, most of which are secret ingredients that are considered proprietary by corporations and governments that are required to protect the public. The lack of transparency in the use and disposal of these materials has led to community and environmental activism and to revelations of environmental and health abuses and catastrophes. This includes contaminated wells, aquifers, and illness amongst wildlife, livestock, and humans (*Hydraulic Fracturing for Natural Gas*) [9].

According to energy efficiency experts, for every dollar spent towards energy efficiency, asset value increases three dollars, and by switching to energy and water-efficient systems, companies can reduce their operating costs by half. This provides a major incentive to participate in regular energy audits, to ensure they are not needlessly wasting money whenever possible.

Contamination reduction is a preventative strategy to reduce pollution, and has considerable potential for improving the health of our environment. Contamination management involves the reduction of toxicity, mobility, and volume of potentially hazardous materials. Contamination can occur in many different industries, from chemical manufacturing and industrial assembly, to energy production, and even on the farms that produce our food and fiber. Industries can contaminate air, water, and soil through their production processes.

Contamination reduction can be accomplished fairly easily across most forms of industry. For example, advanced scrubbers can be installed in smokestacks, wastewater can be treated and reused, and more biodynamic approaches to agriculture—that work with the agricultural ecology—can replace the industrial approaches that often rely on less sustainable or less safe practices.

Clean production requires taking preventative measures during production processes in order to curb the environmental impact of industrial activities. Economic value can be assigned to the benefits of clean production by comparing the cost of production against the cost to the environment. For instance, wastewater treatment is considered a clean production strategy, since the cost of treating the water is far less than the cost of restoring an ecosystem degraded by pollution.

Waste reduction has two different approaches: improved life cycles and waste management. Improving the life cycle of a product requires designing higher quality products, and selecting more durable materials for use in production. While the initial cost of these materials may be slightly higher than others, durability of the end product is significantly improved, which keeps them out of landfills. Waste management is figuring out what to do with the leftover raw materials post-production. In many cases, leftover materials are discarded. However recently there has been an emergence of another method of industrial sustainability known as a waste exchange.

Waste exchanges have become an increasingly popular practice within industry. When an industry uses raw

materials, there is typically some lower grade material in a batch that doesn't meet their specific requirements, or input specifications. Often this is cast aside as waste material, however waste exchanges transfer what is otherwise useless material for one industry, to a different industry that is able to use this waste stream good in their production processes. In this way, waste is minimized, while simultaneously reducing the need for raw natural resources. Companies that have participated in waste exchanges have found that through cooperative efforts, they were both able to improve their bottom line.

Reduced rejection has to do with improving the quality of manufacturing processes, so that fewer end products are rejected due to not meeting quality control standards. Typically, this can be achieved by simply slowing down the manufacturing process so that fewer mistakes are made. Using higher quality materials can also improve the odds that the end product will meet quality control standards. In this way, industry can achieve a higher standard of quality from their manufacturing process.

Dematerialization is the re-engineering of product design in order to use as few raw materials as possible to make a final product. The automotive industry provides a good example of how dematerialization can work effectively. In the past cars and truck bodies were made with steel. Now, lighter metals such as aluminum and composites are being used which require less raw metal and decrease the weight of vehicles to achieve greater fuel-efficiency.

All of the previously mentioned methods and practices can be used to improve the sustainability of industry. However, they all require willing participation from individual manufacturers, with the only incentive being the improvement of their economic efficiency.

#### 4. Ecological Modernization

Ecological modernization has the same goals and philosophy as the methods of Industrial Ecology, seeking to work toward an industrial society in which economic growth and environmental protection can achieve compatibility. The difference is how they seek to accomplish this goal.

Whereas Industrial Ecology has a bottom-up approach within the industrial organization, Ecological Modernization operates from the top-down at a national level. Ecological Modernization relies on policy implementation to provide incentives for individual companies to take action to comply with standards set forth, such as pollution prevention, pollution control, and waste reduction. In return, those companies that comply receive various tax breaks, credits, and in some areas—freedom from regulatory sanction—all while being more green, in a greening marketplace. Essentially, ecological modernization provides a government-sponsored framework that industrial ecology operates within.

#### 5. Conclusions

As industries are the largest consumers of energy and natural resources, making industrial practices more sustainable is key to a more resilient environmental future. Reformation of unsustainable industrial practices presents an enormous opportunity for global sustainability. By reducing energy usage, decreasing resource extraction and processing, and improving the durability and recyclability of manufactured goods, industries can reduce their costs and improve their profits, all while decreasing their environmental impact. Reducing the environmental cost of industrial practices would not only improve the way that industries operate, but also advance a more sustainable approach to our relationship to the natural world.

Fracking requires an immense amount of water, and the amount of water resources devoted for fracking has raised intense concern about potential conflicts for other water needs. In particular, agricultural and ecosystem conflicts often arise when the issue of the water resources required for fracking is discussed. 2.3 million to 3.8 million gallons of water per well are required for fracturing shale gas wells, as reported by the United States Environmental Protection Agency . An additional 40,000 to 1,000,000 gallons of water are required to drill a well (GWPC and ALL Consulting). The sheer volume of the amount of water required for the process results in large transportation costs that are associated with large truck volume and ultimately, wear on roadways. On average, about 700 trucks are implemented to transport water from a typical fracking job. In addition to heavy traffic, road wear and tear is the concern for citizens that reside in areas that experience this traffic. Approximately 20% of the freshwater is used for fracking flows back and is contaminated with various contaminants and chemical (*Water Resources Used in Hydrofracking*) [10].

Currently, fracking water is recycled for reuse; however, in areas where fracking is popular—such as Texas—

water is not very abundant, and therefore, is not always available for fracking. Two solutions have been proposed to further minimize water use. The first suggested alternative is to use wastewater from mines to support the hydro fracking process. Wastewater created from mining can be transported to drilling sites from mines using pipelines. If wastewater is being used for hydraulic fracturing, then there is more freshwater available for cooking, cleaning, and other necessary activities.

The other viable option is propane fracking, a lesser-known way of acquiring natural gas. Instead of pumping water, chemicals, and sand into a well like with hydro fracking, propane fracking requires injecting a propane gel into the bedrock, at high pressures. During the process, the gel is turned into a gas, which is then recovered, sold, or recycled. Given that no water is used in the process, this alternative is clearly more sustainable. More so, this is safer than hydraulic fracturing because water is not being used, and therefore, no wastewater stream is created, making the cleaning process easier.

Recycling fracked water is an attractive environmental option because it will drastically reduce the amounts of freshwater required for the fracking process. Recycling water for fracking can recycle at least approximately 30% of the fracking water with a variety of methods. The state of Pennsylvania reports 90% briny water recycling for usage in additional fracking procedures. There have even been claims that the fracking water can be converted back to a state that is clean and safe enough to be drinking water. Fracked water often contains several contaminants as well as salt quantities. The salt or brine present in the water is useful for the recycling process because this allows companies to reuse the salt content for the next round of fracking. Reuse of both water and salt resources is the advantage from an environmental analysis because this implies reduction of resource consumption, and reduction of wastes and possible toxic chemicals that result as side products.

As a starting point, the government should embrace sustainable industrial development as the centerpiece of its development strategy. Investment is needed in general education (primary through university), technical, engineering, scientific and business education, and industry relevant research and development. The embrace of a sustainable industrial development strategy would mean looking to the domestic market as a basis for the growth of innovative and efficient firms. For example, R&D should be directed not only towards generating globally competitive products and industries but also those designed for domestic markets. A strategy aimed at sustainable industrial development would require a vigorous commitment to minimizing the environmental damage generated by industrial growth. This would entail investing financial resources in strengthening and enforcing environmental regulations, as well as working with firms to develop performance-based environmental management systems. Environmental objectives also need to be integrated into R&D strategies to promote the design of more eco-efficient processes, products and services. A fulsome alternative would also require a restructuring of regional trade and investment rules to promote national capacities for development. (Kevin P. Gallagher Lyuba Zarsky February, 2004) [11].

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