U.S. ENERGY INSECURITY

Why Fracking for Oil and Natural Gas Is a False Solution

food&waterwatch

About Food & Water Watch

Food & Water Watch works to ensure the food, water and fish we consume is safe, accessible and sustainable. So we can all enjoy and trust in what we eat and drink, we help people take charge of where their food comes from, keep clean, affordable, public tap water flowing freely to our homes, protect the environmental quality of oceans, force government to do its job protecting citizens, and educate about the importance of keeping shared resources under public control.

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Executive Summary

Promoters of modern drilling and fracking celebrate the industry's newfound ability to extract oil and natural gas from shale and other tight rock formations, calling it an energy "revolution," a "paradigm-shifter," a "rebirth" and a "game changer."[1] One recent report claims that North America might soon become "the new Middle East," a net exporter of oil and natural gas.[2] In April 2012, ConocoPhillips's CEO at the time called shale gas a "blessing."[3]

But for whom is it really a blessing? Loose talk about domestic oil and natural gas abundance in order to justify and promote widespread drilling and fracking gives Americans a false sense of energy security. Hinging U.S. energy policy on fracking, and thus betting America's future on the supposed abundance of oil and natural gas, would simply perpetuate America's destructive dependence on the oil and gas industry. The only security that would be enjoyed is the security of the industry's profits.

In this report, Food & Water Watch exposes the misconceptions, falsehoods and misleading statements behind the claims that modern drilling and fracking for oil and natural gas can deliver U.S. energy security.

Briefly, Food & Water Watch finds that:

- The popular claim that the United States has 100 years worth of natural gas presumes not only that no place would be off-limits to drilling and fracking, but also that highly uncertain estimates of domestic natural gas resources are accurate;
- Even assuming that the industry's dreams of unrestricted drilling and fracking for natural gas come true and that resource estimates prove accurate, plans to increase the rate of consumption of U.S. natural gas easily cut the claim to 50 years, well within the lifetime of college students today;
- Among these plans are 19 proposals, as of October 26, 2012, to sell U.S. natural gas on foreign markets to maximize oil and gas profits. Combined, these proposals alone mean that annual natural gas exports could reach the equivalent of over 40 percent of total U.S. consumption of natural gas in 2011; and
- Even if the highly uncertain estimates of "tight oil" reserves prove accurate, and even if the oil and gas industry wins unrestricted access to drill and frack for oil, the estimated reserves would amount to a supply of less than seven years.

The United States can transition off of fossil fuels, but it will require remaking the U.S. energy system around proven clean energy solutions: conservation, efficiency and renewables. Such a remaking would underpin broad-based and sustained economic growth, circumvent the environmental and public health costs of extracting and burning fossil fuels and usher in an era of true U.S. energy security, independence and resilience.

The threat is that the fossil fuel industry — empowered by its deep pockets, armed with increasingly intensive extraction methods and bolstered by entrenched infrastructure and demand for its product — will succeed in delaying the necessary transformation for decades, just to protect its bottom line. Now is the time for the United States to declare independence from the oil and gas industry.

Introduction

Americans consume vast amounts of oil and natural gas, and the United States faces energy insecurity as global demand for these fossil fuels increases. Despite the hype, modern drilling and fracking will not change these facts.

The only responsible way to ensure U.S. energy security for future generations is to rapidly transition off of fossil fuels. Yet the American economy currently depends heavily on these dirty sources of energy, and burns them extremely inefficiently. (See box on page 4 and Figure 1 on page 5 for an overview of the U.S energy system.) The United States can and will achieve a transition off of fossil fuels through conservation and through the deployment of proven energy efficiency and renewable energy technologies. The question is whether this transition will take place before or after the fossil fuel industry lays waste to the water we drink, the air we breathe, the communities we love and the climate on which we all depend.

Of course, the true solutions to America's energy challenges — conservation, efficiency and renewables — run counter to the profit motives of the fossil fuel industry. What is their false solution? Develop increasingly intensive methods to extract fossil fuels, deny or dismiss the ways in which extracting and burning these fuels is negatively impacting public health and the environment and continue to rake in extraordinary profits.

In the United States, high-volume hydraulic fracturing, or "fracking," combined with horizontal drilling, is the most prominent and controversial method in the oil and gas industry's arsenal. After drilling down to a targeted rock formation, and then drilling sideways through the targeted layer of rock, operators inject millions of gallons of water mixed with sand and chemicals underground, at extreme pressure, to fracture the rock.[4] The fractures, which after pressure is released are held open by the injected sand, provide pathways for oil and natural gas to flow into the well; otherwise, the oil and natural gas near the drilled well would remain tightly held in the rock.[5]

The oil and gas industry is engaged in a public relations campaign to promote drilling and fracking as good for energy security and energy independence, good for the economy and, in the case of natural gas, even good for the environment.[6] The economic benefits of drilling and fracking are consistently overstated, usually in the form of rosy job projections that, among other details, neglect the long-term costs to local communities.[7] And while natural gas does burn more cleanly than oil and coal, the claims of environmental benefit ignore harmful pollution both during and in the wake of drilling and fracking.[8] As for global climate change, the growing scientific consensus is that natural gas is a false solution.[9]

In this report, Food & Water Watch exposes the misconceptions, falsehoods and misleading statements behind the claims that drilling and fracking for oil and natural gas is the path to American energy security and energy independence.

Within the United States, foreign companies are acquiring stakes in oil resources that can now be extracted with fracking,[10] but regardless of where the oil is produced and who produces it, the price of oil is set on the global market.[11] Such globalization means that widespread drilling and fracking for oil in the United States will do nothing for American consumers who are paying the high price of oil. The only way that Americans can insulate themselves against high oil prices is to consume less oil. But doing so by using natural gas creates its own set of problems, and serves the oil and gas industry's bottom line by prolonging America's destructive dependence on fossil fuels.

Terms of the Debate

What do the terms *energy security* and *energy independence* mean, and how are the two concepts related?

Energy security: The U.S. Congressional Budget Office defines U.S. energy security as "the ability of U.S. households and businesses to accommodate disruptions of supply in energy markets."[31] The CBO goes on to explain, "Households and businesses are 'energy secure' with respect to a particular source of energy if a disruption in the supply of that source would create only limited additional costs."[32]

Energy independence: Energy independence typically refers to U.S. independence from foreign sources of oil, or oil self-sufficiency, and the term is commonly but mistakenly equated with energy security.[33]

As long as large amounts of oil fuel the American economy, American consumers will be at the mercy of growing global demand for oil and the high costs of extracting the oil that remains underground.[34] This is because the price of oil is set on a global market, and American consumers pay this price through gasoline and other refined oil products regardless of where the oil was produced.[35] Reduced oil consumption, not reduced oil imports, must therefore be the focus if the United States is to achieve energy security *with respect to oil*, in the sense defined by the CBO.

The U.S. Energy System

Energy Sources

Petroleum: The U.S. Energy Information Administration estimates that in 2011, burning liquid fuels derived from oil, such as gasoline, diesel, jet fuel and fuel oils, accounted for over 28 percent of total U.S. energy consumption.[12] Gasoline alone accounted for about 16 percent of total U.S. energy consumption, not counting ethanol energy content.[13] The energy content of all petroleum liquid fuels, not just those combusted, was about 36 percent of total U.S. energy consumption in 2011.[14]

Natural Gas, Coal and Nuclear: Natural gas, coal and nuclear, respectively, accounted for about 26 percent, 21 percent and 8 percent of the estimated total of 2011 U.S. energy consumption.[15] Coal and nuclear sources of energy are used predominantly to generate electricity, whereas only about 31 percent of U.S. natural gas consumption in 2011 went toward electricity generation.[16]

Renewables: Consumption of renewable energy, such as wind and solar power, grew the fastest among all energy sources from 2010 to 2011. Renewables, including hydropower, made up 7 percent of total U.S. energy consumption, primarily to generate electricity, although this counts only marketed electricity from renewables.[17]

Energy Uses and Losses

Electricity: An estimated 41 percent of the total U.S. energy consumption in 2011 was used to generate electricity, but about two-thirds of this energy consumed for electricity was wasted.[18] Energy content of nuclear and fossil fuels is wasted during the generation of electricity through heat losses as turbines are driven, for example, by steam or other pressurized gas.[19] On average, U.S. electricity generation results in the loss of about 51 percent of natural gas energy content and 64 percent of coal energy content.[20] In addition to energy wasted during electricity generation, 7 percent of generated electricity is lost along transmission lines and through other distribution infrastructure.[21] Unlike nuclear and fossil fuels, there are no environmental or public health costs associated with wasted wind, solar or other renewable sources of energy.

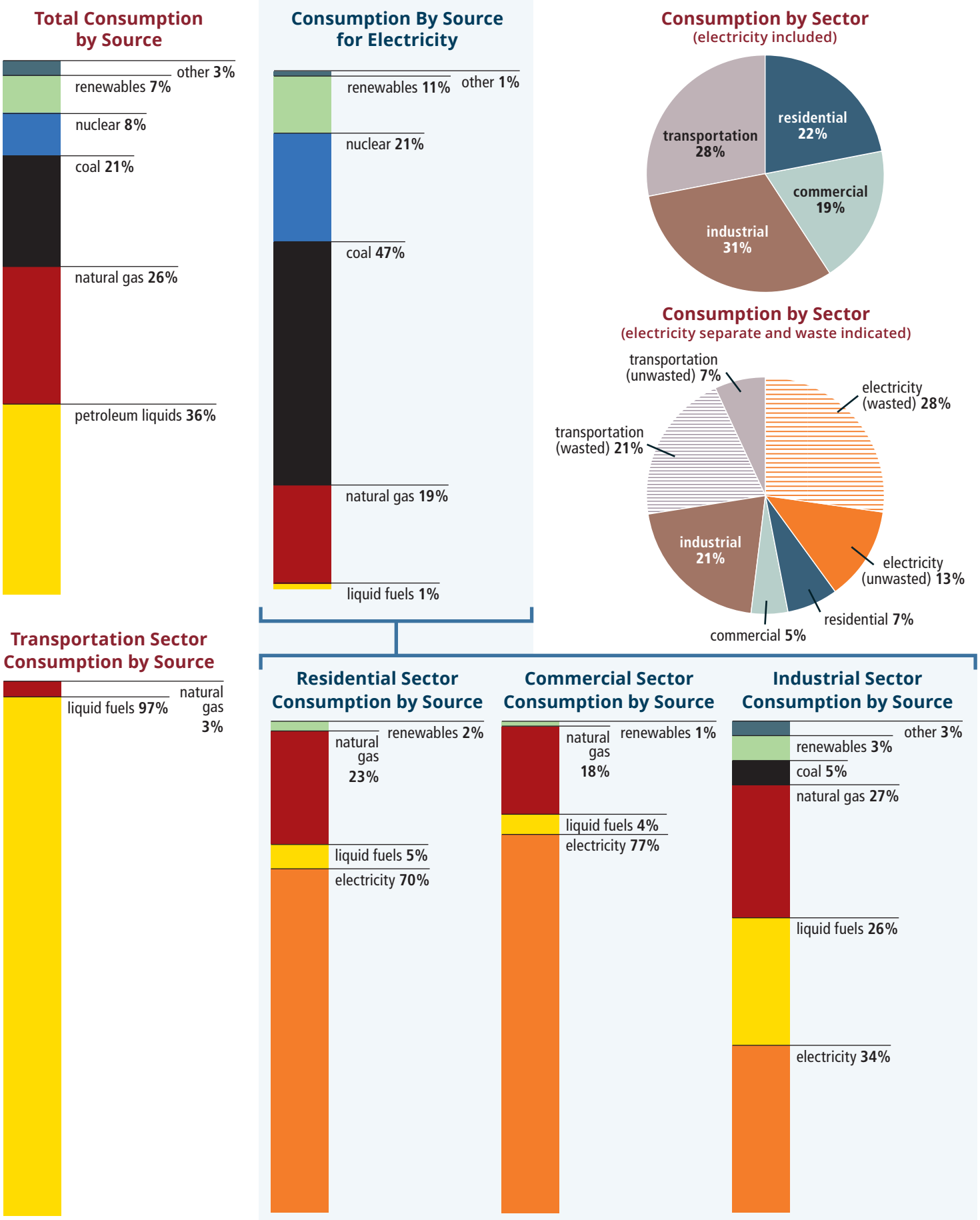
Transportation: The transportation sector accounted for an estimated 28 percent of total U.S. energy consumption.[22] Almost all of this consumption (about 97 percent) was of oil, in the form of various refined petroleum products.[23] According to Lawrence Livermore National Laboratory, about 75 percent of all energy consumed in the transportation sector is wasted.[24]

Residential, Commercial and Industrial: Electricity is consumed in large amounts by the residential, commercial and industrial sectors, but these sectors also directly consume varying amounts of natural gas and varying amounts of liquid fuels derived from oil.[25] Electricity generation accounted for an estimated 70 percent of residential energy consumption, 77 percent of commercial energy consumption and 34 percent of industrial energy consumption.[26] In the industrial sector, direct use of liquid fuels and natural gas amounted to an estimated 26 and 27 percent, respectively, of energy consumption.[27] Meanwhile, in addition to natural gas consumed indirectly in the form of electricity, direct use of natural gas amounted to 23 and 18 percent of total energy consumption within the residential and commercial sectors, respectively.[28]

Fossil Energy's Consequences

Almost all U.S. greenhouse gas emissions come from extracting and burning oil, natural gas and coal.[29] The United States is already experiencing the impact of global climate change due to these emissions, including episodes of extremely hot weather, severe storm events and changes in the timing of seasons.[30] Continuing to burn fossil fuels will only worsen the future consequences and societal costs of global climate change.

Figure 1. 2011 U.S. Energy Consumption



SOURCE: Government Accountability Office; U.S. Census Bureau

Oil and Natural Gas Basics

The U.S. Energy Information Administration (EIA) defines crude oil as a liquid mixture of "hydrocarbons" — molecules composed of hydrogen and carbon atoms.[44] Natural gas is simply a mixture of these hydrocarbons in the gas phase, consisting primarily of methane. Having just one carbon atom, methane is the simplest of hydrocarbons, and it is known to be a potent greenhouse gas contributing to global warming.[45]

Additional household names of hydrocarbons include ethane (two carbon atoms), propane (three carbon atoms) and butane (four carbon atoms). Together, these and heavier hydrocarbons (i.e., more than four carbon atoms per hydrocarbon molecule) form the so-called "natural gas liquids."[46] Natural gas and natural gas liquids are commonly associated with and produced along with crude oil.

Discussion of oil consumption is complicated by general use of the term "oil" to refer to both crude oil and natural gas liquids.[47] The EIA's estimates of total oil production, for instance, include natural gas liquids and crude oil.[48] As a broader term, "petroleum" encompasses crude oil, natural gas liquids and the refined products of these liquids, ranging from gasoline and diesel to jet fuel and asphalt.[49]

Crude oil, natural gas liquids and natural gas are present in underground "source rocks" as the buried and broken-down remnants of organisms that lived hundreds of millions of years ago. Over millennia, since the formation of these fossil fuels, a large amount has migrated away from source rock, seeping through sandstone or other permeable bedrock either to the Earth's surface or to a geological trap, where it can collect over time to form an isolated reservoir.[50]

Historically, oil and gas development has relied on finding such reservoirs. Now, in sharp contrast, modern drilling and fracking allows the industry to extract the oil and gas straight out of source rocks, bypassing the need to find geological traps containing any oil and gas that left those source rocks.[51]

Of course, not all of the oil or natural gas held in a source rock can be extracted. Only a fraction of the in-place resources are considered "technically recoverable" using current technology, and this is without taking into consideration the costs of extracting the resources.[52]

Using natural gas to displace oil for transportation, or to displace coal for electricity, is playing a zero-sum energy security game. Building the infrastructure necessary to displace significant quantities of oil consumed by the transportation sector requires enormous investments.[36] Likewise, increased use of natural gas for electricity generation also requires large, long-term investments in infrastructure.[37] Such investments would guarantee U.S. dependence on natural gas for decades.

However, given large uncertainties in estimates of natural gas reserves,[38] serious environmental and public health risks posed by drilling and fracking[39] and notorious volatility in natural gas prices,[40] locking-in decades of U.S. dependence on natural gas could prove to be a colossal mistake, resulting in a net negative for U.S. energy security with respect to natural gas. And such investments are likely to preclude the long-term public investments needed to modernize the U.S. energy system and transition off of fossil fuels.[41]

The Decline of Conventional Oil and Natural Gas Production

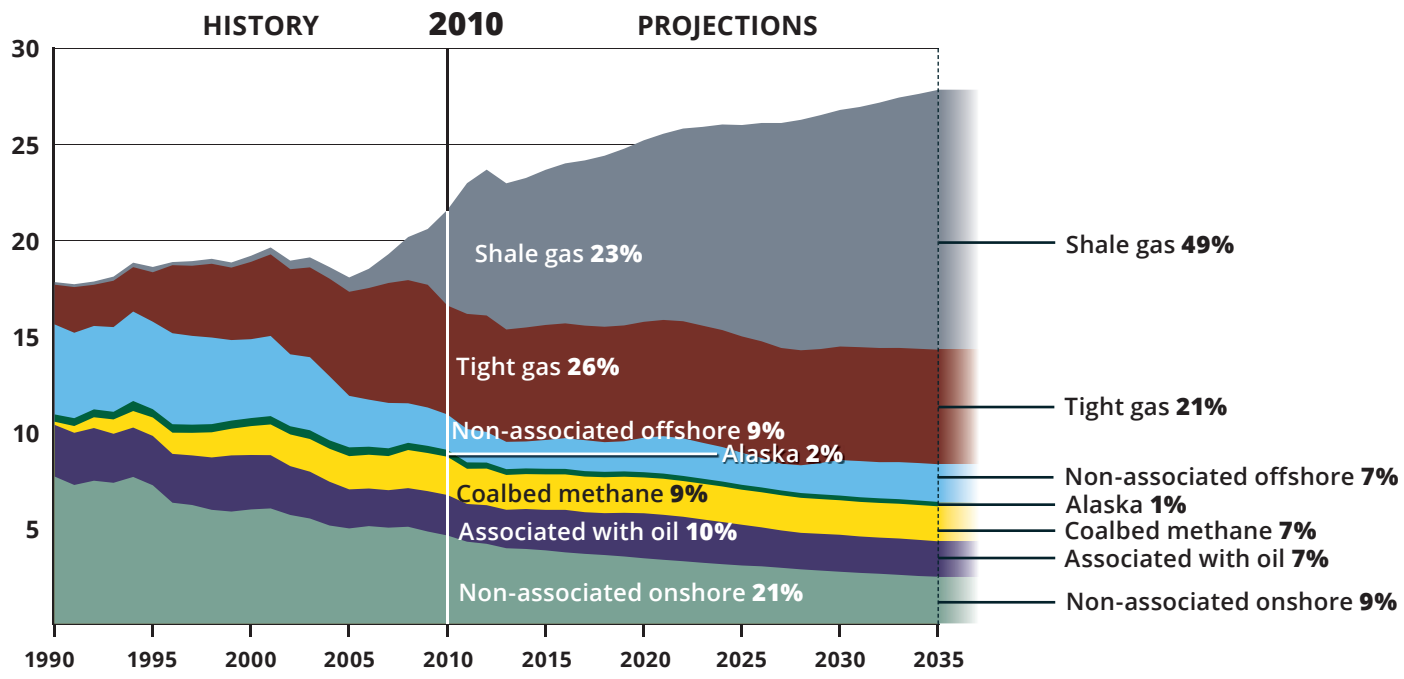
Modern drilling and fracking is best understood in the context of the oil and gas industry's struggle to compensate for declining production from already-discovered oil fields, and in the context of the industry's need to make up for lack of access to much of the world's supply, about 80 percent of which is controlled by foreign governments.[42] Many of these governments are either unstable or unfriendly to international oil corporations.[43]

It has been over 40 years since the discovery of the last of the 40 "super-giant" oil fields — conventional oil fields estimated to have between 5 and 50 billion barrels of "technically recoverable resources" of oil (see box at left for basic background on oil and gas).[53] For perspective, the United States consumed an estimated 6.9 billion barrels worth of petroleum products and crude oil in 2011 alone.[54]

According to one peer-reviewed analysis of global oil production published in 2012, "More than two thirds of current crude oil production capacity may need to be replaced by 2030, simply to keep production constant."[55] This means that there is a growing gap between increasing global demand for oil and what can be supplied by conventional, relatively low-cost methods of extracting oil.[56] Energy analysts have described this new reality as the "end of cheap oil."[57]

In the United States and in almost all European members of the Organisation for Economic Co-operation and

Figure 2. Past and Projected U.S. Natural Gas Production, 1990–2035
TRILLION CUBIC FEET



Growing Dependency on Fracking: *As U.S. production of natural gas from conventional sources declines, the EIA projects that production from shale and other tight rock formations that require fracking will increase.*[58] **SOURCE:** U.S. EIA

Development (OECD), the story is similar with respect to natural gas.[59] Conventional natural gas production is on the decline (see Figure 2) at the same time that global demand for natural gas is expected to grow.[60]

Reduced oil and gas consumption — through conservation, efficiency and renewables — would make Americans less vulnerable to the economic consequences of the growing gap between global demand and conventional supply. But the oil and gas industry's prescription is to try to bridge declines in conventional supply with ever-more intensive methods of extracting oil and natural gas, methods that become profitable as prices climb. They aim to keep "peak oil" production at a plateau for as long as possible.

The Rise of Modern Drilling and Fracking

In the Bakken formation beneath parts of North Dakota and Montana, in the Utica and Marcellus shale beneath Pennsylvania and surrounding states and in the Barnett and Eagle Ford plays in Texas, the oil and natural gas is held tightly, stuck in place and unable to flow. Numerous other states from New York to Florida to California also lie above oil and natural gas source rock.[61]

When operators drill a new shale well, they can only really hope to extract the natural gas that just happens to be ingrained within the part of the source rock that they drill into, or that is present in any faults or natural fractures that the new well passes through. In general, any oil and natural gas in the shale or other tight rock formation that surrounds a well will remain stuck there, unless and until fracking creates a pathway for it to flow out.

Over the past decade, relatively high natural gas prices spurred the industry to develop new drilling and fracking technologies, building on decades of publicly funded research.[62] These technologies, now also being applied to extract oil, make drilling and fracking source rock potentially profitable, depending on the prices of oil and natural gas.

Source rocks such as shale tend to be much more expansive than they are thick.[63] Now, with new drilling technologies, operators are able to drill down several miles to reach a targeted layer of shale, and then drill horizontally through it as far as two miles or more.[64] (See Figure 3, page 8.) Drilling horizontally through shale or other tight rock formations exposes much more of the relatively thin layer of source rock to the well, compared

to simply fracking a well that is drilled vertically through this thin layer. Once drilling is finished, operators have the technology to isolate and frack multiple sections along the horizontal leg of a well. In the Bakken formation, for example, operators are now capable of fracking the horizontal portion of a well in up to 40 different stages.[65]

Drilling and fracking for "shale gas" — natural gas trapped in underground shale rock formations — has boomed since about 2005, resulting in significant growth in natural gas production.[67] While advances in technology have brought down costs, modern drilling and fracking for oil and natural gas is significantly more cost-intensive than conventional oil and gas development.[68] As a consequence, shale gas development requires higher natural gas prices in order to actually be profitable.[69] Yet, for a variety of reasons discussed below, the shale gas industry became detached from this reality.

By April 2012, increased natural gas production, combined with lower demand due to a sputtering economy and an abnormally warm 2012 winter, had driven the "wellhead price" for natural gas down from a recent high of over $10 per thousand cubic feet (mcf) in July 2008 to under $2 per mcf.[70] In 2010, ExxonMobil bought into the shale gas boom, becoming the largest producer of natural gas in the country with its purchase of XTO Energy, but by June 2012 CEO Rex Tillerson stated that because of low natural gas prices, "We are all losing our shirts today.... We're making no money [on natural gas]. It's all in the red."[71] That is because natural gas price levels were far below those needed for the industry to break even, given the cost of drilling and fracking new shale gas wells.

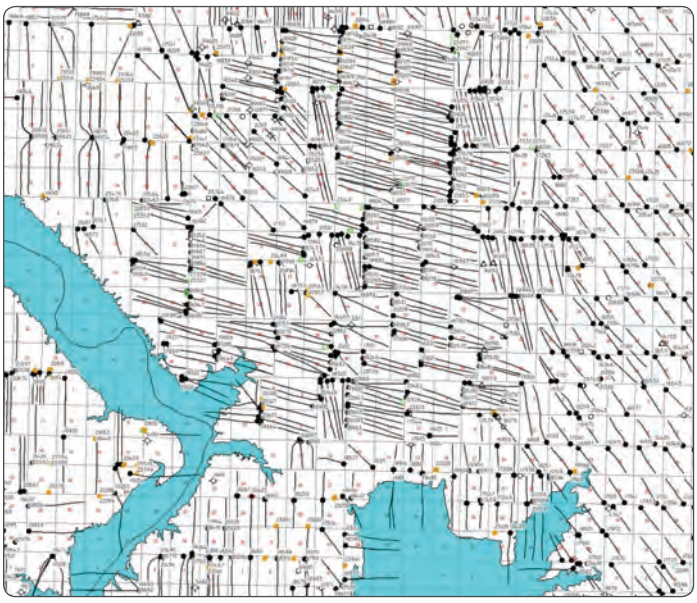


Figure 3. ***Coming to a watershed near you?***

Fracked horizontal wells tunnel beneath Lake Sakakawea on the Upper Missouri River, turning the landscape of western North Dakota into a pincushion of oil wells.[66] *Each dashed square is one square mile.*

SOURCE: North Dakota Department of Minerals Management

The natural gas price that a specific company needs to break even depends on how productive its specific portfolio of wells will be. Well productivity varies significantly both within a shale gas play and between plays,[72] and drilling costs can also vary from play to play due to differences in the respective depths of the targeted formations or other local factors, such as land values.[73] As a consequence, break-even prices likewise vary within and between plays.

Analysis of production from shale wells in the Barnett, Fayetteville and Haynesville plays has suggested that the average break-even price in each play is above $8 per mcf.[74] This is more than four times what the wellhead price of natural gas was in April 2012. Excluding the cost of securing leases and general and administrative expenses, the estimated break-even price for these plays was about $6 per mcf.[75] Similarly, the International Energy Agency estimated the cost of producing shale gas in 2010 at between $4 and $9 per mcf.[76] Now, this does not mean that if prices are below $4 per mcf that no shale gas wells will be profitable; a highly productive well drilled into a "sweet spot" may be, especially if it produces natural gas liquids. But it is misleading to suggest, as some analysts do, that because of these sweet spots, the break-even price for producing shale gas is lower than $4 per mcf.[77]

A number of factors contributed to the industry continuing to drill and frack for natural gas despite low natural gas prices.[78] A primary reason is that the terms of many leases required operators to actively drill or else these leases would expire.[79] To generate enough money to actually pay for the drilling and fracking, some companies flipped leases they held or entered into joint ventures with foreign companies, who were either interested in learning modern drilling and fracking methods or interested in gaining access to U.S. natural gas resources (see box on page 9). In a revealing call with investors in October 2008, Chesapeake Energy CEO Aubrey McClendon said, "I can assure you that buying leases for X and selling them for 5X or 10X is a lot more profitable than trying to produce gas at $5 or $6 mcf."[80] The oil and gas industry's thirst for hydrocarbon reserves — a proxy for future earning potential — in the face of declines in conventional oil and gas may explain the eagerness to buy such leases.[81]

Drilling and fracking for tight oil, primarily in the Bakken formation in North Dakota and Montana and the Eagle Ford shale in Texas, and for natural gas liquids in so-called "wet" shale gas plays, has allowed the industry to capitalize on high prices of oil, as well as apparently buy time until U.S. natural gas prices rise.[95] According to Baker Hughes, from 2000 until the summer of 2009, at least three-quarters of all drilling rigs operating in the United States were drilling natural gas wells, and the rest were drilling for oil.[96] But since mid-2009, drilling rigs have fled natural gas plays to drill instead for oil.[97] By late August 2012, just 25 percent are listed as drilling for natural gas and 75 percent are drilling for oil.[98]

Natural gas production remains high despite reduced drilling in the "dry" shale gas plays, in part because significant amounts of natural gas are produced along with tight oil and natural gas liquids.[99] Locking-in future increases in demand for U.S. natural gas — through increased consumption in the transportation and electricity sectors and through increased exports to foreign markets — appears to be part of the industry's long-term strategy for ensuring that natural gas prices are high enough to make shale gas development profitable.

Shale Gas Euphoria: America's False Sense of Energy Security

The oil and gas industry's plans to export shale gas, America's supposed ticket to energy security, reveal that the only thing the industry seeks to secure is its bottom line. But the oil and gas industry's push to increase U.S. dependence on natural gas in the transportation and electricity sectors is perhaps even more insidious.

After as much natural gas as possible is extracted from the United States, the country's dependence on natural gas to fuel transportation and generate electricity would persist. Decades from now this dependence could leave the country in need of natural gas imports. American consumers would then be exposed to global demand for natural gas just as they currently are for oil. The United States would also be left behind those countries that chose to invest, instead, in clean energy solutions.[100]

It is true that modern drilling and fracking have contributed to significant increases in the EIA's estimate of technically recoverable natural gas resources in the past decade.[101] A popular claim is that, as a result, the United States has enough natural gas to last it 100 years.[102] However, Food & Water Watch took a close look at this claim and found that it assumes that the industry gets its wish of completely unrestricted access throughout Alaska, throughout the lower 48 states and all along the U.S. coastline. The claim also sweeps under the rug significant uncertainties that are inherent to estimating technically recoverable shale gas resources.

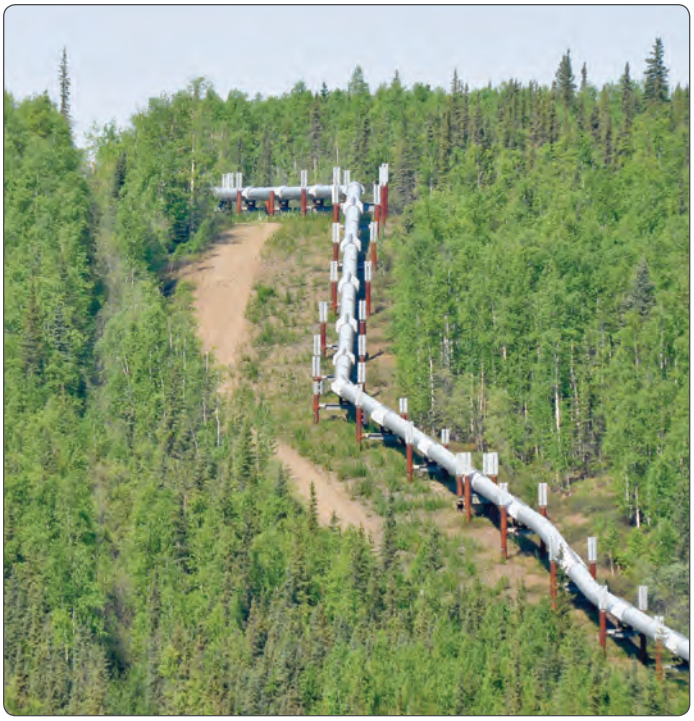
Foreign Companies With Stakes in U.S. Shale Gas and Tight Oil Plays

Netherlands:	Royal Dutch Shell[82]
United Kingdom:	BP[83]
	BG Group[84]
Norway:	Statoil[85]
France:	Total SA[86]
Spain:	Repsol YPF SA[87]
India:	GAIL (India) Limited[88]
China:	Sinopec[89]
	China National Offshore Oil Corp.[90]
Japan:	Sumitomo Corp.[91]
	Marubeni Corp.[92]
	Mitsui & Co.[93]
Australia:	BHP Billiton[94]

Nonetheless, even if the oil and gas industry gets its wish of unrestricted access and even if preliminary estimates of shale gas reserves prove accurate, Food & Water Watch calculates that the industry's plans to increase demand for U.S. natural gas could easily cut in half the claim of a 100-year supply.

Justification for the claim of a 100-year supply comes from taking the EIA's January 2012 estimate of the total "proved" and "unproved" amounts of technically recoverable natural gas resources — about 2,214 trillion cubic feet (tcf) — and dividing by the amount of natural gas consumed in the United States in 2010, which was about 24.1 tcf.[103] So, assuming that Americans consume the same amount each year, the EIA's estimate of 2,214 tcf of natural gas would last about 92 years.

It is important to realize that shale gas accounts for only about a quarter of the estimated 2,214 tcf of natural gas; specifically, the EIA estimate of 2,214 tcf includes 60 tcf of proved shale gas reserves[104] and 482 tcf of unproved shale gas reserves,[105] for a total of 542 tcf. Under the assumption that annual U.S. consumption stays constant at the 2010 rate, 542 tcf equates to about 22 years worth of shale gas.



These calculations raise three important questions:

- If shale gas makes up 22 years out of the estimated 92 years of natural gas, where is the other 70 years of supposed natural gas supply?
- How uncertain are unproved technically recoverable natural resources?
- Even if all of the unproved technically recoverable resources of natural gas could be extracted, how long would the natural gas actually last in light of plans to export it overseas and plans to use more of it to fuel transportation and generate electricity?

U.S. natural gas "abundance" presumes that the industry will drill and frack everywhere

The oil and gas industry dreams of unrestricted drilling access in Alaska and along the entire U.S. coastline, not just within the lower 48 states.[106] The claim of 100 years of natural gas is nothing but a repackaging of this dream.

Taking the EIA's estimate of 2,214 tcf of natural gas and subtracting its estimate of 542 tcf in shale gas yields 1,672 tcf of technically recoverable natural gas that is not tied up in shale.[107] According to the National Petroleum Council, there is about 300 tcf in Alaska and about 400 tcf from the *entire* U.S. Outer Continental Shelf and other offshore areas in the lower 48 states, including the Great Lakes.[108] Presumably, this approximately 700 tcf — or about 30 of the projected 92 years — is included among the 1,672 tcf of non-shale technically recoverable natural gas resources. Extracting all of it entails giving the oil and gas industry unrestricted access to drill not only throughout Alaska but also all along the Pacific, Gulf of Mexico and Atlantic coasts.

The National Petroleum Council acknowledges, "The technical challenges to developing domestic gas resources are compounded by urban growth, competing land use, and changing public values that increasingly constrain existing and new natural gas development."[109] The claim of about 100 years of natural gas, however, completely ignores this reality. It envisions an America so dependent on the oil and gas industry that no place is off-limits to drilling.

U.S. natural gas "abundance" relies on highly uncertain resource estimates

According to a 2010 Congressional Research Service report, "proved reserves" are defined as: "The quantities of hydrocarbons estimated with reasonable certainty to be commercially recoverable from known accumulations under current economic conditions, operating methods, and government regulations. Current economic conditions include prices and costs prevailing at the time of the estimate."[110] By contrast, "unproved reserves" are "[q]uantities of hydrocarbon resources that are assessed based on geologic and engineering information similar to that used in developing estimates of proved reserves, but technical, contractual, economic, or regulatory uncertainty precludes such reserves from being classified as proved."[111]

To arrive at an estimate of the technically recoverable resources in an emerging shale gas or tight oil play, the EIA uses the total area of the play and the expected density of wells within the play to calculate a total number of expected wells.[112] This total number of wells is adjusted by additional parameters to account for the portion of the play that is untested (i.e., for which there is no production data), and for the portion of the play believed to have production potential.[113] The total reserve estimate then follows from taking the resulting hypothetical number of expected wells, and multiplying by the "estimated ultimate recovery" (EUR) of oil, or natural gas, expected over the lifetime of each well, presumed to be 30 years.[114]

EUR is the primary source of uncertainty in estimates of oil and natural gas technically recoverable from shale and other tight rock formations.[115] This is in large part because there is no long-term production data — since shale gas and tight oil development are so new, and each shale play is different — to serve as a basis for predicting how rapidly

shale gas or tight oil production will decline over time for a collection of wells within a specific play.[116] Projecting what gradual decline might look like 30 years out, based on just a few initial years of steeply declining production, is a highly uncertain process.[117]

The EIA takes the latest data on how much oil or natural gas is produced from a collection of wells and then extrapolates from these data over time, using a specific shape of decline given by a "hyperbolic" function.[118] The steep declines in production of a typical shale gas well over the first few years means that new wells must be drilled and fracked each year just to maintain production — this has been likened to a treadmill.[119]

While calculating EURs for conventional oil and gas reserves is an established science,[120] many of the assumptions on which this science is based are violated in the context of extracting oil and natural gas from shale and other tight rock formations.[121] The uncertainty surrounding EUR calculations lies at the root of a June 2011 investigation by the *New York Times*, which was full of revelations, including; "An internal Energy Information Administration document says companies have exaggerated 'the appearance of shale gas well profitability,' are highlighting the performance of only their best wells and may be using overly optimistic models for projecting the wells' productivity over the next several decades."[122]

As stated in the discussion of break-even prices, the amount of shale gas that can be produced from a well varies significantly within a shale gas play.[123] As a consequence, as "sweet spots" in the play are identified, operators drill and frack the most productive portions of the play first, leaving the less productive and thus less profitable portions of the play for later. Since within a play, the cost of drilling and fracking a well is essentially the same, the less productive portions of plays may only become profitable once natural gas prices rise. While these portions of the play hold shale gas that is technically recoverable, the gas is not economically recoverable.

This pattern in well productivities means that just to sustain a constant level of shale gas production, the rate of drilling and fracking must increase — it's an accelerating treadmill. And extracting all of the estimated U.S. shale gas resource presumes that operators can increase the pace of drilling and fracking indefinitely; they must always be able to access and profitably tap new but less productive source rocks as natural gas prices rise. This is what widespread drilling and fracking means: a future in which the United States is turned into a pincushion of oil and gas wells. As these wells age over decades, a large fraction of them will fail to contain methane and other hydrocarbon gases, in many cases putting at risk underground sources of drinking water.[124]

How quickly might U.S. natural gas be consumed?

Even if the oil and gas industry gets its wish of unrestricted access, and even if preliminary estimates of shale gas reserves prove accurate, drilling and fracking will not deliver long-term U.S. energy security. Food & Water Watch calculates that the EIA's baseline projection of future domestic consumption, current proposals to export natural gas and plans to increase natural gas demand in the transportation and electricity sectors would drastically reduce the period of time that estimated reserves could last, further undercutting the industry's claims about U.S. energy security (see box).

100 years worth of natural gas?
Not likely and no thanks

Even assuming that the oil and gas industry wins unrestricted access to drill and frack and assuming that estimates of unproven resources are accurate, increased demand for U.S. natural gas could easily cut in half the claim of a 100-year supply.

Popular claim:
100 years

Holding consumption constant at 2010 level:
92 years

Using the EIA's projected growth in rate consumption:
78 years

And supposing, from 2026 to 2045, liquefied natural gas exports reach 60 percent of currently proposed capacity:
72 years

And supposing that, by 2025, natural gas displaces the energy equivalent of 40 percent of 2011 demand for gasoline and diesel:
58 years

And supposing that, by 2025, natural gas is used to generate electricity equivalent to 50 percent of the electricity generated by coal in 2011:
50 years

First, when the EIA estimates that there is 92 years worth of technically recoverable natural gas, it does not factor in its own baseline projection of increased natural gas consumption; recall that the estimate assumes that natural gas consumption would be the same each year as it was in 2010. The EIA, however, currently projects that between 2010 and 2035, U.S. natural gas consumption will increase, on average, by 0.4 percent annually.[125] **Incorporating this projection, and further assuming that consumption continues to grow at this rate beyond 2035, Food & Water Watch calculates that the estimated 2,214 tcf of proved and unproved technically recoverable natural gas resources, if accurate, would last about 78 years.**

But the 0.4 percent annual growth rate is for domestic consumption, and it is a baseline figure based on current laws and regulations.[126] For instance, it does not account for the rapidly growing number of applications to the U.S. Department of Energy seeking authorization to export liquefied natural gas (LNG) to foreign markets (see table on page 13).

As opposed to oil, the supply chain for natural gas is not yet globalized.[127] Large regional price differences — due in part to natural gas prices being linked to oil prices in some markets — explain the oil and gas industry's recent interest in exporting natural gas from the United States.[128] In mid-July 2012, for example, *The Economist* reported, "Whereas American gas currently costs about $2.50 [per million British thermal units (mBtu)], European oil-indexed pipeline gas goes for around $12 [per] mBtu, and in Asia LNG can fetch $16 [per] mBtu or more."[129] Note that 1 million Btu of natural gas is approximately equivalent to 1,000 cubic feet of natural gas.[130] According to *The Economist*, "Liquefying the gas, carrying it to its destination and regasifying it can cost between $4 and $7 [per] mBtu",[131] so the industry has an opportunity to make significant profits exporting natural gas.

Such exports clearly belie the industry's patriotic rhetoric on U.S. energy security and energy independence, revealing profit as the true motive. In addition to foreign interests having stakes in U.S. shale gas plays,[132] some have already signed contracts, or are pursuing contracts to import U.S. natural gas.[133] This raises questions about whether these foreign interests will influence how much natural gas gets exported overseas. Meanwhile, American communities would be left with the potentially costly legacy of environmental pollution in the wake of drilling and fracking.[134]

As of October 26, 2012, the U.S. Department of Energy had received applications to export a combined total of 28.39 billion cubic feet of natural gas per day.[135] If all applications were to be approved, this capacity would amount to about 10 tcf per year, which is about 40 percent of all U.S. natural gas consumption in 2011.[136]

To demonstrate how such exports might impact the "92 years of supply" claim, Food & Water Watch conservatively assumes a scenario in which LNG exports, from 2016 to 2026, ramp up to 60 percent of the export capacity proposed as of October 26, 2012, reaching about 6 tcf. This of course neglects any additional applications after October 26, 2012. Food & Water Watch further assumes that LNG exports stay at 60 percent of currently proposed capacity for 20 years, from 2026 through to 2045, followed by a 20-year period in which LNG exports decline steadily down to zero to reflect the likely convergence in natural gas prices around the world.[137]

Food & Water Watch calculates that the estimated 2,214 tcf in proved and unproved technically recoverable natural gas resources, if accurate, would last about 72 years under such an LNG export scenario, along with the EIA's projection of 0.4 percent growth in annual U.S. consumption.

Finally, plans to stimulate increased U.S. demand for natural gas in the transportation and electricity sectors would further cut into the claimed 100 years of natural gas.[138]

To illustrate the effect that such plans might have, Food & Water Watch first assumed a scenario in which, on top of the EIA's projected baseline consumption, the use of natural gas as a transportation fuel increases gradually

Proposed LNG Export Capacity Amounts to Over 40 Percent of 2011 U.S. Natural Gas Consumption

Applications Received by the Department of Energy to Export Domestically Produced LNG From the Lower 48 States (as of October 26, 2012)

Company	Initial application date filed	Proposed export capacity (billion cubic feet per day)	Facility location (if applicable)
Sabine Pass Liquefaction, LLC	August 11, 2010	2.2	Cameron Parish, LA
Freeport LNG Expansion, LP and FLNG Liquefaction, LLC	December 17, 2010	1.4	Quintana Island, TX
Lake Charles Exports, LLC	May 6, 2011	2.0	Lake Charles, LA
Carib Energy (USA) LLC	June 6, 2011	0.04	third-party liquefaction
Dominion Cove Point LNG, LP	September 1, 2011	1.0	Calvert County, MD
Jordan Cove Energy Project, LP	September 22, 2011	2.0	Coos Bay, OR
Cameron LNG, LLC	November 10, 2011	1.7	Cameron Parish, LA
Freeport LNG Expansion, LP and FLNG Liquefaction, LLC	December 20, 2011	1.4	Quintana Island, TX
Gulf Coast LNG Export, LLC	January 10, 2012	2.8	Brownsville, TX
Gulf LNG Liquefaction Company, LLC	May 2, 2012	1.5	Pascagoula, MS
LNG Development Company, LLC	May 3, 2012	1.25	Warrenton, OR
SB Power Solutions Inc.	May 7, 2012	0.07	third-party liquefaction
Southern LNG Company, LLC	May 15, 2012	0.5	Savannah, GA
Excelerate Liquefaction Solutions I, LLC	May 25, 2012	1.38	Calhoun County, TX
Golden Pass Products, LLC	August 17, 2012	2.6	Sabine Pass, TX
Cheniere Marketing, LLC	August 31, 2012	2.1	Corpus Christi, TX
Main Pass Energy Hub, LLC	September 11, 2012	3.22	16 miles offshore LA
CE FLNG, LLC	September 21, 2012	1.07	Plaquemines Parish, LA
Waller LNG Services, LLC	October 12, 2012	0.16	Cameron Parish, LA
Daily total (billion cubic feet per day)		**28.39**	
Annual total (trillion cubic feet per year)		**10.36**	
U.S. consumption of natural gas, 2011 (trillion cubic feet)		**24.5**	

SOURCES:

Export capacities: U.S. Department of Energy, Office of Fossil Energy. "Summary of LNG export applications." November 1, 2012.

2012 Applications: "2012 LNG Import/Export Authorization Applications." Available at http://www.fossil.energy.gov/programs/gasregulation/authorizations/2012_Long_Term_Applications.html, accessed November 1, 2012.

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until 2025, reaching 40 percent of current demand for motor gasoline and distillate fuels, and that the use of natural gas in transportation stays at this level thereafter. **Food & Water calculates that the estimated 2,214 tcf in proved and unproved technically recoverable natural gas resources, if accurate, would last about 58 years under such a scenario of natural gas displacing oil for transportation fuels.**[139]

As for using natural gas instead of coal to generate electricity, Food & Water Watch assumes that natural gas consumption by the electricity sector increases steadily over the baseline so that, by 2025 and beyond, 50 percent of the amount of electricity generated using coal in 2011 is generated instead using natural gas. **Adding this assumption to the above scenarios, and accounting for differences in efficiencies between coal-fired and natural gas-fired electricity genera-**

tion,[140] such an increase in natural gas consumption would mean that the estimated 2,214 tcf in proved and unproved technically recoverable natural gas resources, if accurate, would last about 50 years.[141]

This sequence of simple calculations demonstrates that, even if the oil and gas industry is granted unrestricted access to extract any and all natural gas it can find, the current estimated supply is far from the energy panacea the industry claims. If allowed to write its own policies, the oil and gas industry will simply extract as much as possible, as fast as possible, for maximum profit, while fighting to prolong America's destructive dependence on fossil fuels. Then, once U.S. natural gas is gone, the global oil and gas industry will likely be well positioned to import foreign sources of fracked natural gas to feed this dependence; Royal Dutch Shell and ExxonMobil, in particular, are invested in building a global natural gas supply chain.[142] Their strategic plans for such a global supply chain serve as an illustration of how Big Oil sees an opportunity, not a threat, in using natural gas in addition to oil to fuel transportation.[143]

Tight Oil Euphoria: Empty Promises of Oil Independence

Amid the fervor over drilling and fracking for tight oil, Americans are hearing empty promises that U.S. energy independence is within reach.[144] In a 2012 report, Citigroup, a global financial institution, went so far as to suggest that North America could become the "new Middle East by the next decade; a growing hydrocarbon net exporting center...."[145] But consider that foreign companies are buying stakes in U.S. tight oil plays, establishing joint ventures with U.S. companies and providing the capital necessary to drill and frack.[146] These foreign companies stand to profit, of course, as tight oil from the wells in which they have a stake is sold on the global market. So, when American consumers buy the gasoline or diesel from this tight oil, are they really consuming domestic oil, or are they consuming foreign oil?

With respect to energy security, it doesn't matter. The globalized market for oil means that reducing oil consumption is the only way American consumers can inoculate themselves against the high oil prices that will result from increased global demand for oil, coupled with increased costs to extract the oil that remains underground.[147] Another consequence of the globalized oil market is that, regardless of whether the oil Americans consume is produced domestically or produced abroad, so long as Americans consume a lot of it, the United States is likely to spend billions of dollars, if not tens of billions of dollars, on military operations to secure Middle East oil shipments in an effort to ensure stable global oil prices.[148]

But the reality is that tight oil from drilling and fracking is just a drop in the bucket of U.S. oil consumption. The United States consumed about 18.8 million barrels of oil per day in 2011,[149] yet it produced only an estimated 0.55 million barrels of tight oil per day.[150] The EIA does project that tight oil production will increase, but to only about 1.2 million barrels per day between now and 2020, peaking at 1.33 million barrels per day in 2029 before starting to decline.[151] This peak would amount to only about 7 percent of the 18.8 million barrels per day consumed in the United States in 2011.

And then there is the reality on the ground of what it would take to achieve such levels of production. An analysis of hundreds of wells producing tight oil from the Bakken formation illustrates that production follows the pattern not just of a treadmill, but of an accelerating treadmill — just to sustain a constant level of production, a larger number of new wells must be drilled and fracked each year.[152]

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As for reserves, the EIA estimates that there is 33.2 billion barrels of technically recoverable tight oil, with all the caveats and uncertainties outlined above for similar estimates of shale gas.[153] For perspective, 33.2 billion barrels of tight oil wouldn't last seven years if consumed at a rate of 15 million barrels per day, well below the current rate of U.S. consumption. In 2011, the United States accounted for over 20 percent of global oil consumption, but it contributed only about 9 percent of global oil production and possessed less than 2 percent of the world's proved oil reserves.[154]

Clearly, the promises are empty that U.S. oil independence is within reach, thanks to drilling and fracking. It is also clear that widespread drilling and fracking for tight oil will do next to nothing for American consumers.[155] In fact, while these consumers pay historically high prices at the pump, the industry is maximizing their profits by exporting record amounts of gasoline and diesel.[156]

Peter Orszag, former director of the Office of Management and Budget in the Obama administration and now currently at Citigroup, has put forward a slightly different argument, suggesting that the development of tight oil could push down global oil prices by loosening concerns over declining world oil supplies.[157] Leonardo Maugeri, an Italian oil executive currently at Harvard's Kennedy School of Government as a research fellow, has added, "The U.S. shale/tight oil could be a paradigm-shifter for the oil world, because it could alter its features by allowing not only for the development of the world's still virgin shale/tight oil formations, but also for recovering more oil from conventional, established oilfields...."[158]

Bestowing such faith on the oil and gas industry, and on the global oil market, is misguided, perhaps most importantly because it ignores the threat of global climate change. But even if such speculation about the potential of tight oil proved correct, the result would get the United States nowhere in its quest for energy security. Facilitated by low oil prices, high consumption would persist once the tight oil in the country is gone, and the United States would be right back where it started: it would be dependent on foreign sources of oil — it's just that the foreign oil being imported would be tight oil, or other oil produced by unconventional methods. Meanwhile, the global oil and gas industry would continue to profit from America's dependence on it.

Fracking Euphoria: A Threat to Long-term U.S. Energy Security and Independence

The EIA estimates that extracting the technically recoverable resources of shale gas and tight oil would require drilling and fracking over 630,000 new wells.[159] But what happens after that?

Modern drilling and fracking, together with deepwater drilling and tar sands oil, are just the current generation of the industry's unconventional extraction methods.[160] As oil and natural gas become increasingly valuable on global markets, these approaches will intensify and new, even more costly extraction methods will be pushed by the industry.[161] Oil shale (as opposed to shale oil), ultra-deep offshore oil, Arctic oil and methane hydrates are all in the oil and gas industry's sights.[162] For the oil and gas industry, drilling and fracking simply provide a bridge to the next generation of its false solutions to America's energy challenges.

It is not too late for the United States to avoid going down this self-destructive path. Long-term U.S. energy security and independence can actually be achieved, but the country needs to act now to deploy existing energy efficiency and renewable energy solutions and invest in future technologies that expand these solutions.[163]

These solutions will eliminate the hidden costs of burning fossil fuels, resulting in enormous environmental and public health benefits.[164] Acting now will also help to ensure that the United States is a global leader in supplying clean energy technologies to the rest of the world.[165] In addition, building and maintaining local, resilient energy systems that are characterized by energy efficiency and that rely on distributed renewable power generation — instead of on centralized, wasteful and polluting fossil fuel power — will create and sustain local jobs.[166] Such energy systems will also spare communities

the inevitable economic drag that future oil and natural gas price increases will cause as global demand grows and global supply is consumed.[167]

But remaking how energy is produced and consumed in the United States requires large investments in infrastructure and aggressive changes in policy.[168] Currently, the fossil fuel industry's established infrastructure — its pipelines, power plants and transmission lines — makes it difficult if not impossible for clean, renewable energy resources to compete.[169] Over a trillion dollars in "sunk" costs in such infrastructure favors the status quo of dependence on the oil and gas industry, serving as a barrier to the remaking of the U.S. energy system.[170]

The oil and gas industry has been supported, directly or indirectly, by decades of federal policies favorable to the industry.[171] This includes billions of dollars in tax breaks annually,[172] low costs charged by the government when the industry leases public lands,[173] federal spending on research and development beneficial to the industry[174] and limits on liability that allow the industry to foist operational risk onto the federal government.[175] Such giveaways to the oil and gas industry dwarf the total federal incentives received by the renewable energy sector.[176]

Oil and gas companies continue to enjoy corporate welfare in the form of permanent tax breaks; at the same time, uncertainty over whether Congress will renew clean energy tax incentives, or will let them expire, throws a wrench in private investments in clean energy.[177] This contrast highlights the extent to which the fossil fuel industry has skewed American energy policy to further its bottom line.[178]

On the one hand, the fossil fuel industry is funding an array of groups pushing to allow renewable energy production tax credits to expire.[179] On the other hand, the oil and gas industry's generous campaign donations are proving to be a good investment, particularly given the outcome of the March 2012 vote in the U.S. Senate on whether or not to end tax subsidies to the oil and gas industry, which are estimated to cost the American public $24 billion in forgone revenues over the next decade.[180]

During the 2011–2012 election cycle alone, the oil and gas sector gave about $2.2 million in campaign contributions to the 47 Senators who voted to keep the tax subsidies in place, compared to a total of $674,160 to the 51 Senators who voted in favor of ending the subsidies (60 votes were required to end the filibuster).[181] Including all campaign donations from 1989 to early September of 2012, the same 47 Senators had raked in a total of about $24.4 million from the oil and gas sector, while the 51 Senators who voted in favor of ending the subsidies had been given a total of about $6.1 million.[182]

Despite the entrenched advantages that the fossil fuel industry enjoys, wind energy can now outcompete coal and has become competitive with natural gas on a "levelized" cost basis for new power installations.[183] However, the potential expiration of production tax credits, generally low electricity demand due to a struggling economy and the currently low prices of natural gas all combine to threaten the domestic wind industry.[184] In particular, the looming end of production tax credits is creating a rush to finish installations by the end of 2012, which could be disruptive to the industry in 2013.[185]

The fossil fuel industry further benefits, and the clean energy industry suffers, from the overall failure of the market, vis-à-vis energy prices, to account for the true societal costs of the industry's pollution, particularly the current and future costs of global climate change.[186]

Conclusion and Recommendations

Drilling and fracking simply serve the myth — a very profitable myth for the oil and gas industry, and a very destructive one for the American public — that the United States can drill its way to energy security and energy independence.

The popular claim of a 100-year supply of natural gas is based on the oil and gas industry's dream of unrestricted access to drill and frack, and it presumes that highly uncertain resource estimates prove accurate. Further, the claim of a century's worth of natural gas ignores plans to export large amounts of it overseas and plans for more domestic use of natural gas to fuel transportation and generate electricity. Even if the oil and gas industry's dreams come true and even if the uncertain resource estimates prove accurate, increasing production to feed global demand for exports and meet planned increases in domestic consumption could easily cut the 100-year-supply claim in half.

As for oil, drilling and fracking for tight oil in the United States is just a drop in the bucket of global oil production, and since oil is priced on a global market, drilling and fracking will do next to nothing for American consumers.

The United States can transition off of fossil fuels, and in the process achieve long-term energy security, independence and resilience, by remaking the U.S. energy system. To this end, Food & Water Watch urges state and local governments and the federal government to:

- Enact aggressive energy conservation policies, including large public transportation investments and widespread deployment of energy efficiency solutions, to reduce energy demand;
- Establish ambitious programs for deploying and incentivizing existing renewable energy technologies to increase clean energy supply;

- Modernize the U.S. electrical grid so that it caters to distributed renewable power generation;
- Make sweeping investments in research and development to overcome technological barriers to the next generation of clean energy solutions; and
- Terminate all public funding, including tax expenditures, that not only pads the profits of the fossil fuel industry but also further entrenches America's dependence on fossil fuels.

The time is now for Americans to end their destructive dependence on the fossil fuel industry.

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