Spring 2013

The Infinite and the Finite: An Analysis of the United States' Energy Future

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Spring 2013

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Preface

Energy is the core of industrialization. It is essential for development and modernization, and yet it is also a source of conflict and geopolitics. I developed a profound interest in resource geopolitics while studying at the University of Texas at Austin, which has spurred further research while in Geneva, Switzerland. This essay combines my interests in geopolitics with my fascination of the environment and my dream that humanity could develop in a sustainable and environmentally friendly way.

Acknowledgments

Thanks to my father, Jeff Voorhis, for inspiring me to learn more about shale gas and renewable energy-- spurring my beliefs and challenging my opinions at every turn. A massive thanks to my mother, Catherine Voorhis, for supporting me and listening to me speak for hours about my paper. Thank you to Dr. Gyula Csurgai for taking an interest in my topic, being willing to support my ideas, and offering advice when I most needed it. And finally, thanks to all of my interview contacts who provided a plethora of information and documentation!

Abstract

Last year the *New York Times* published a newsworthy article stating that the United States could become "Energy Independent" from the tumultuous OPEC countries. This groundbreaking revelation, supported by statistics from the International Energy Agency, claimed that newfound energy resources were spread throughout North America in the form of shale oil and gas. Politicians and the public clung to this possibility in the face of strenuous relations with the Middle East as the Arab Spring and the War on Terror waged on. However, the consequences of becoming "energy independent" have not been considered. What are the geopolitical implications of pursuing energy independence? What are the effects the search for shale oil and gas will have on more sustainable energy sources, like renewable energy? What will happen as the search for unconventional fuels begin? This research project will focus on these geopolitical questions of renewable energy and the rise of unconventional fossil fuels and end with a policy recommendation based on the information provided in this essay to promote a sustainable energy future.

Introduction

A decade ago scientists, esteemed professors, and massive oil corporations feared the imminent decline of petroleum resources. Fears of OPEC nations in the midst of revolution, fears of another 1973 Oil Embargo, and fears of validating "Hubbert's Model of Peak Oil" stemmed the search for alternative energy. What they found shocked the nation. In 2009, shale oil and shale gas deposits were discovered throughout the United States and Canadian regions. These so called "Unconventional Fuels" are vast in quantity, so much so, that in 2012 the International Energy Agency posited that the United States could become energy independent. This "Shale Gas Revolution" has created much political and environmental hype and will continue to affect energy policies around the world for the foreseeable future.

Methodology: This essay will be split into four parts. The first will cover the history and definition of the Shale Gas Revolution and renewable energy. The second part will focus on the geopolitical implications that "energy independence" will have for the United States and the Middle East due to the rise in unconventional fuels. The third part will elucidate the implications the rise of unconventional fuels will have for renewable energy development. The reason both of these factors will be analyzed is because they are inextricably linked to any foreign policy and domestic policy that is created within the United States—the perceived geopolitical consequences of the Shale Gas Revolution will divert investment of renewable energy towards a resource that is "tried and true". However, the same geopolitical consequences (i.e. energy independence) are possible if the United States develops renewable energy. It is important to connect the geopolitical consequences of shale gas to the implications for renewable energy. This essay will end with an analysis of policy recommendations which requires changing the

mentality of depleting finite resources towards implementing renewable resources for lasting sustainable development and absolute energy independence.

Thesis: As the geopolitical and environmental consequences of shale gas and renewable energy are taken into account, it is important to remember that the recent rise in unconventional fuels within the United States can only be considered as temporary. Shale gas and tight oil are finite resources and it is imperative that energy policies search for cleaner, more sustainable sources of energy. In the end, unconventional fuels, like shale gas, only provide a cushion of time for the world to implement renewable energy infrastructure: it is neither a permanent strategy nor a lasting economic tactic. It is the goal of this essay to provide a basis of understanding of the Shale Gas Revolution, geopolitically and environmentally, as a transitory energy resource.

PART 1: Background on Shale Gas and Renewable Energy

History of Shale Gas

The United States has known about shale gas since the mid-19th Century; however shale gas was never fully developed or pursued until the beginning of the 21st Century due to varying economic circumstances. In 2008, a global economic recession hit the United States and dramatically affected oil prices. This oil crisis harkened back to the 1973 Oil Embargo and fears of high oil prices opened the door to the domestic production of unconventional gas. The goal of the United States was to supplement foreign oil imports with domestic gas production. However, in 2009, the United States Geological Survey found massive deposits of shale gas which caused "US domestic production to rise from 50.7 billion cubic feet per day (bcfd) in 2006 to 57.4 bcfd

in 2009", easily turning the tables on foreign oil.[1] And thus, the Shale Gas Revolution began. This "revolution", so to speak, presents a unique opportunity for the United States to cease being a net importer of fuel to becoming a net exporter.[2] The implications for such a revelation intrigued the nation. The media grasped onto the idea of "energy independence" and the politicians clung to the thought of cheap and relatively clean *domestic* energy.[3] This boom in unconventional gas has been a contentious topic of discussion due to rising uncertainty of availability, accessibility, and sustainability. The next few sections will define shale gas, describe production, present predictions, and explain current policies in order to form a complete basis for understanding the implications shale gas will have geopolitically and environmentally.

Definition of Shale Gas

Shale gas is part of the fossil fuel family that is labeled as "unconventional" due to traditionally being considered difficult or costly to extract. There are three forms that unconventional gases take: shale gas, tight gas, and coalbed methane. This essay will focus on the exploration of shale gas. Shale gas is defined by the International Energy Agency as "natural gas contained within a commonly occurring rock classified as shale. Shale formations are characterized by low permeability, with more limited ability of gas to flow through the rock than is the case with a conventional reservoir. These formations are often rich in organic matter and, unlike most hydrocarbon reservoirs, are typically the original source of the gas".[4] Many of these shale reservoirs overlie conventional deposits, which have been extensively explored over the

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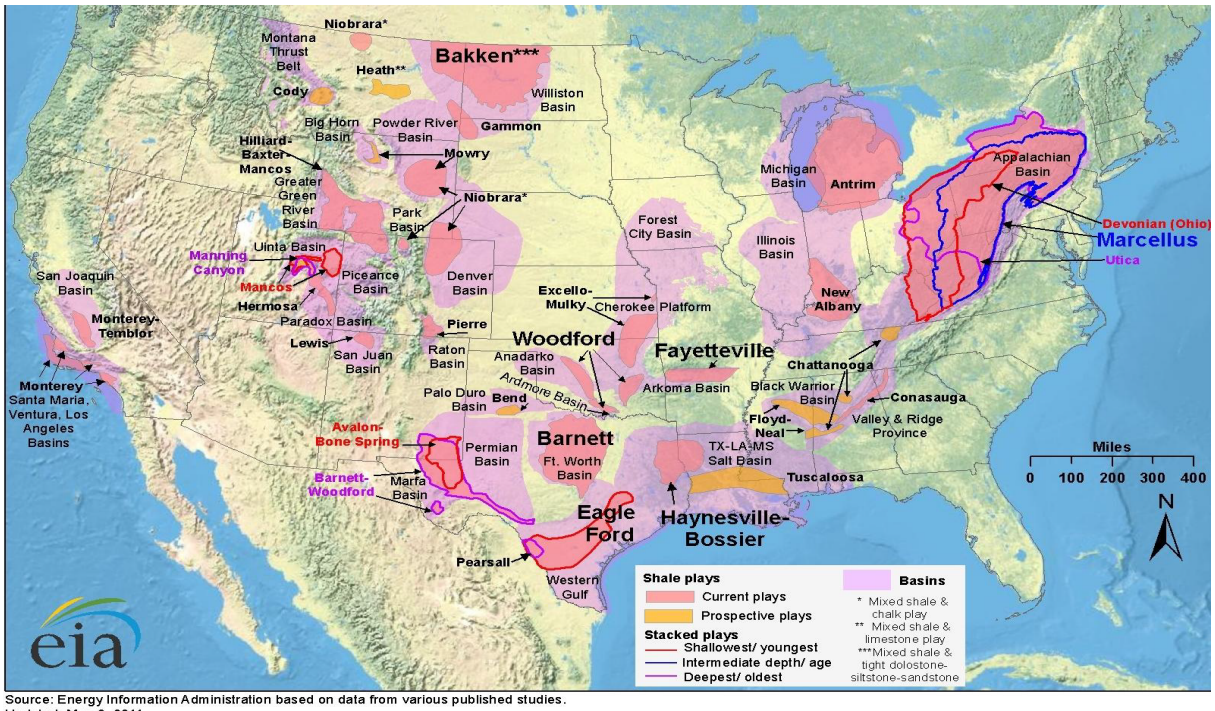
[1] Stevens, Paul. *The 'Shale Gas Revolution': Hype and Reality*. Chatham House, 2010. Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.

[2] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

[3] Krauss, Clifford, and Eric Lipton. "U.S. Inches Toward Goal of Energy Independence." *New York Times*, March 22, 2012. Accessed April 11, 2013. http://www.nytimes.com/2012/03/23/business/energy-environment/inching-toward-energy-independence-in-america.html?pagewanted=all.

[4] International Energy Agency. *Golden Rules for a Golden Age of Gas*. International Energy Agency, 2012. Pg. 18, Accessed April 9, 2013. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf.

last 150 years; this has given the United States a head start in investigating possible shale plays[5]… "These [shale plays] include the Barnett, Haynesville, Fayetteville and Woodford shales in Texas, Louisiana, Arkansas and Oklahoma, along with the Marcellus shale that underlies portions of the states of Pennsylvania, West Virginia and New York. The past year has also seen substantial activity in the Eagle Ford shale in Texas and the Bakken shale in North Dakota"[6] [See map below]. This definition of shale gas explains why this fuel has not been previously exploited, however as the Age of Fossil Fuels dwindles in decline every resource has become fair game for production. The era of cheap energy is gone, but it doesn't mean we are out of options.



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

[5] Stevens, Paul. *The 'Shale Gas Revolution': Hype and Reality*. Chatham House, 2010. Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.

[6] Jacoby, Henry D., Francis M. O'Sullivan, and Sergey Paltsev. "The Influence of Shale Gas on U.S. Energy and Environmental Policy." *International Association for Energy Economics*, v. 1, no. 1 (2012). Accessed April 9, 2013. http://www.iaee.org/eeep/EEEP01_01_A05_Jacoby-EPUB/eeepissue.aspx.

Production of Shale Gas

Production of shale gas requires the use of newly evolved technology, combining horizontal drilling and hydraulic fracturing (commonly known as "Fracking"). "Hydraulic fracturing, developed initially in the late 1940s is used when rock permeability is extremely low, as in the case of shale gas or light tight oil. It often takes the combination of horizontal wells and hydraulic fracturing to achieve commercial rates of production. Advances in the application of these two techniques, in combination, largely explain the surge in shale gas production in the United States since 2005".[7] However, this "fracking" is an intensive industrial process that tends to have "a larger environmental footprint than conventional gas development" often producing noxious gas emissions (methane, carbon dioxide, and volatile organic compounds), air pollution, and groundwater contamination.[8] The International Energy Agency mentions in their 2012 report, *Golden Rules for a Golden Age of Gas*, that unconventional gas production often results in higher airborne emission of hazardous Greenhouse Gases than conventional production.[9] Regardless of this fact, shale gas is still considered as a cleaner fuel to burn. However, much to the displeasure of environmentalists, large volumes of fresh water mixed with harmful chemicals are used during the hydraulic fracturing process: "each well might need anything between a few thousand and 20,000 cubic meters (between 1 million and 5 million gallons) in order to push the gas out of shale".[10] The risk of leakage into water resources as well as risk of depleting current freshwater resources to meet production needs has created plenty of "anti-fracking" sentiment, thus limiting expansion. Additionally, production of shale gas has also faced constraints due to uncertainty. Shale gas was not profitable before this combined "fracking" technology because

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[7] International Energy Agency. *Golden Rules for a Golden Age of Gas*. International Energy Agency, 2012. Pg. 18, Accessed April 9, 2013. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf.
[8] Ibid.
[9] Ibid.
[10] Ibid.

"different parts of the (generally large) shale deposits will also have different characteristics: small "sweet spots" or "core areas" may provide much better production than the rest of the play, often because of the presence of natural fractures that enhance permeability. The amount of natural gas liquids (NGLs) present in the gas can also vary considerably, with important implications for the economics of production".[11] This uncertainty of the exact location of "sweet spots" hindered further development of shale gas production until 2009 when funding became available for geologic research. Since then the United States "annual shale gas production has grown from 1.0 trillion cubic feet in 2006 to 4.8 trillion cubic feet in 2010. Shale gas' overall contribution to the nation's total natural gas supply is expected to grow from 23% in 2010 to 46% by 2035".[12] The implications of this significant increase will be furthered analyzed in the geopolitical section of this essay.

Predicted Amounts of Shale Gas

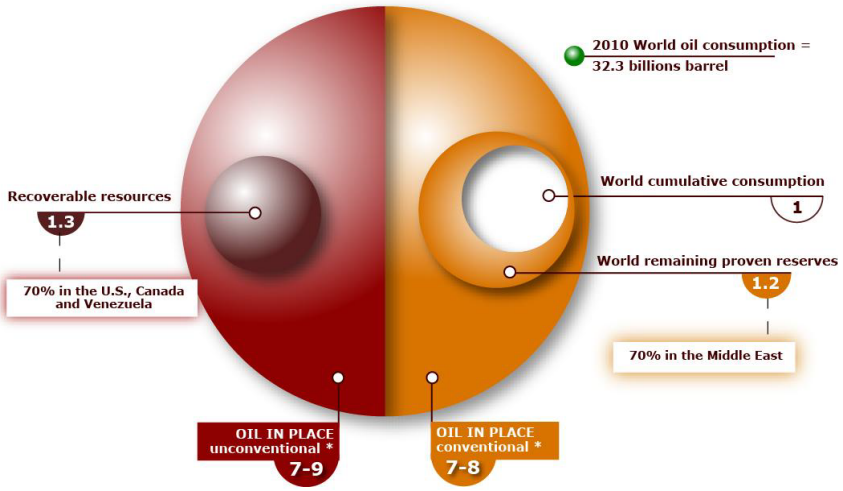
Why put so much effort into the production of a fuel that is difficult to access, difficult to locate, and difficult to produce? Because the predicted amounts of fuel beneath domestic soil could provide enough energy for the next 230 years *minimum.*[13] Each energy corporation, oil company, and international organization has their individual figures and statistics for the predicted amounts of shale gas that are recoverable in the United States for the next few decades, but they all come to the same conclusion: the future is dependent upon shale gas. In the International Energy Agency's most recent *World Energy Outlook*, the "remaining technically recoverable resources are now estimated at 200 trillion cubic meters (tcm) for shale gas – this includes the latest estimates from the US Energy Information Administration (EIA) for the

[11] Ibid.

[12] The University of Texas at Austin Energy Institute. *Annual Report 2011/2012*. Austin, TX: University of Texas at Austin, 2011. Accessed April 13, 2013. http://www.energy.utexas.edu/images/stories/utei-annualrpt2011-12_online.pdf.

[13] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

United States: 81 tcm for tight gas and 47 tcm for coalbed methane. In total, natural gas resources amount to 790 tcm, [equaling] more than 230 years of production at current rates".[14] While the 2013 BP Energy Outlook states that "shale gas and coal bed methane (CBM) will account for 63% of North American production by 2030. Sustained growth of shale gas raises the prospect of LNG exports from North America by 2030" (5 Bcf/d).[15] As the world population nears 9 billion people, "energy demand in developing nations (Non OECD) will rise 65 percent by 2040 compared to 2010, reflecting growing prosperity and expanding economies. According to Exxon Mobile 2013 Outlook, global energy demand will grow 35 percent by 2040".[16]



Source: Maugeri, Leonardo. *Oil: The Next Revolution.* Harvard Kennedy School, 2012.

The revolutionary discovery of shale gas will be used in the coming years to assuage this increase in demand. However, despite the excitement of finding more energy resources, it must be acknowledged that there is the risk of "uncertainty in the United States [of whether or not] the current rise in shale gas production can be increased or indeed even maintained. It has already been pointed out that gas from shale plays has a much faster rate of depletion than gas from

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[14] Ibid.

[15] BP. *BP Energy Outlook 2030*. London: BP, 2012. Accessed April 13, 2013. http://www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/O/2012_2030_energy_outlook_booklet.pdf.

[16] ExxonMobile. *The Outlook for Energy: A View to 2040*. ExxonMobile, 2013. Accessed April 9, 2013. http://www.exxonmobil.com/Corporate/Files/news_pub_eo2013.pdf.

conventional fields".[17] Thus it is imperative that domestic energy policies that support production of shale gas also continue to fund renewable sources of energy.

History and Definition of Renewable Energy

Renewable energy as defined by the International Energy Agency is any energy "derived from natural processes (*e.g.* sunlight and wind) that are replenished at a faster rate than they are consumed. Solar, wind, geothermal, hydro, and some forms of biomass are common sources of renewable energy".[18] Renewable energy was the first source of energy for mankind as the burning of biomass (wood and tree litter) allowed for the first *Homo sapiens* to heat their shelters and cook their food. However, since the discovery of the potent fossil fuels, renewable energy has played a minor role in the lives of modern civilization.

Renewable energy is primarily a source of domestic energy; it is rarely exported or imported to meet energy demands. Furthermore, renewable energy has always been produced for electricity or heat. Only recently has biomass (in the form of ethanol or biodiesel) or solar energy been harnessed for the transportation sector. However, these uses of renewable energy make up less than 20% of total energy usage for the last few decades in the United States.[19] Environmentally, renewable energy is advantageous in producing negligible greenhouse gas emissions, while remaining an inexhaustible resource for energy production. This is explained by the fact that "most renewable energies fall into the category of kinetic energy which uses motion to create electricity or heat; whereas most fossil fuels are based on potential energy in which

[17] Stevens, Paul. *The 'Shale Gas Revolution': Hype and Reality*. Chatham House, 2010. Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.
[18] International Energy Agency. "Renewable Energy." 2013. Accessed April 13, 2013. http://www.iea.org/aboutus/faqs/renewableenergy/.
[19] Ibid.

energy must be released through combustion or chemical conversion".[20] This combustion or chemical conversion produces large amounts of carbon dioxide emissions, while kinetic energy is the stable production electricity without inefficient externalities.

In recent years, renewable energy has gained more leeway in the energy market due to the threat of climate change. However, renewable energy lags behind in production due to lack in investment as fossil fuels remain the more economically profitable and familiar course of action. This section will create a basis of understanding the production, prediction, and policies behind renewable energy and how it will be affected by the Age of Fossil Fuels and the Shale Gas Revolution.

Production of Renewable Energy

There are multiple types of renewable resources used for energy production; however this essay will focus on three prominent types used within the United States: solar, wind, and biomass. According to the International Energy Agency, "the world relied on renewable sources for around 13.1% of its primary energy supply in 2009".[21] Compared to the United State Energy Information Administration which states that only 11% of domestic energy within the United States is generated from renewable resources.[22] In simple terms, fossil fuels account for 85% of total energy in the United States; the leftover 15% is further partitioned into hydropower, biomass, solar, and wind. It is evident from these statistics that renewable energy is not the primary focus of the United States energy policy.

Regarding the production of solar energy in the United States, there are three different production methods. The first type includes the active and passive forms of solar thermal

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[20] Smith, Zachary A., and Katrina D. Taylor. *Renewable and Alternative Energy Resources*. ABC-CLIO, Inc. 2008.

[21] International Energy Agency. "Renewable Energy." 2013. Accessed April 13, 2013. http://www.iea.org/aboutus/faqs/renewableenergy/.

[22] United States Energy Information Administration. *Annual Energy Outlook 2013*. U.S. Energy Information Administration, 2012. Accessed April 9, 2013. http://www.eia.gov/forecasts/aeo/er/executive_summary.cfm.

systems in individual buildings; wherein the building is designed to capture sunlight in the form of heat by strategic placement of windows and openings or through collectors using a liquid-medium. The second type uses photovoltaic (PV) panels that transform light-waves into electricity. These are the most commonly seen solar power tools and can be installed on individual buildings or in a "solar farm". The latest technological use of solar power is called the Central Solar Power (CSP) system. This system requires a "solar farm" in which mirrors or reflecting panels are placed strategically to bounce sunlight to a central location (either a tower or tube) that concentrates the heat to power turbo-generators.[23] All of these technologies are ready for market penetration, however due to lack of investment; development of these technologies is pricey.

Similarly, wind power has been a minor source of energy for hundreds of years. Windmills and newly developed horizontal wind turbines produce a substantial amount of energy each year. Texas and California are the leading states within the United States for wind power, but this renewable source of energy still lags behind the development the fossil fuels like shale gas and tight oil. Wind is created from the differential heating of the Earth's surface by the sun; this means that it is a variable source of energy.[24] The wind does not blow every day in the same place, just as the sun does not shine 365 days a year. However, wind power is very low-energy intensive and has the potential to compete in a fossil-fuel dominated market because of cheap production costs.

Of the renewable energy used within the United States, biomass is the most promoted and utilized. In their book, *Renewable and Alternative Energy Resources*, Smith and Taylor state that "due to its extremely versatile nature, biomass can be used in any application that fossil fuels are

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[23] Smith, Zachary A., and Katrina D. Taylor. *Renewable and Alternative Energy Resources.* ABC-CLIO, Inc. 2008.
[24] Ibid.

used in. It can be used to generate electricity, for commercial and residential heating, and for transportation. It has surpassed hydropower as the most used renewable energy source in the United States".[25] Biofuel and biomass will be the easiest renewable resource to begin an energy transition away from fossil fuels without having to modify the United States infrastructure significantly. Like shale gas and shale oil, biomass is based on potential energy that requires combustion to create heat and energy. Combustion of biomass can emit carbon dioxide, but biomass also acts as a carbon sink—meaning it sequesters carbon as the crops grow.

This explanation for the production of solar, wind, and biomass resources is to provide a basic understanding of the benefits renewable energy has. Each of these resources are essentially inexhaustible, though they may be variable as to where they can be developed. The next section will focus on the predicted amounts each of these resources could supply in the future.

Predicted Amounts of Renewable Energy

Most predictions by the United Nations Environmental Programme (UNEP) and the International Energy Agency (IEA) provide scenarios that deem biofuels as the top competitor for fossil fuels if renewable energy is pursued. However, there are various predictions to the extent renewable energy will play in the future. The IEA considers "energy security and diversification of the energy mix is a major policy driver for renewables. Growth of renewables generally contributes to energy diversification, in terms of the technology portfolio and also in terms of geographical sources. Use of renewables can also reduce fuel imports and insulate the economy to some extent from fossil fuel price rises and swings. This certainly increases energy security. However, concentrated growth of variable renewables can make it harder to balance power systems, which must be duly addressed".[26] In their 2012 *World Energy Outlook*, the IEA

[25] Ibid.

[26] International Energy Agency. "Renewable Energy." 2013. Accessed April 13, 2013. http://www.iea.org/aboutus/faqs/renewableenergy/.

states that global electricity generation from renewable energy sources grows 2.7 times between 2010 and 2035.[27] Other predictions see solar and wind energy potentially providing 20% of the world's electricity, while biomass could "provide for over half of the world's energy needs by 2050".[28] The greatest obstacle renewable energy faces is initial investment and government support. Without investment or support, the inefficiencies that are typically associated with renewable energy, such as inadequate energy storage, will remain in place.

United States' Energy Policies: The Unconventional and the Renewable

The current energy policies in the United States support the usage of fossil fuels, but claim to continue funding for renewable energy. This section will provide a brief overview of current energy policies within the United States to create a basis of understanding for future energy recommendations.

There are three levels of policies within the United States: international, national, and state. The only level that regularly executes environmental actions is the state level. This means that regardless of the United Nations' "Sustainable Energy for All" initiative "which calls for a global target of doubling the share of renewable energy by 2030"[29] or the International Energy Agency's "New Policies Scenario" which provides a list of "Golden Rules" that unconventional gas industries must comply with or lose their "social license to operate". [30] The national and state levels do not have to ratify, sign, or implement any of these international policies. This is evident when the United States refused to ratify both the Kyoto Protocol to cut carbon emissions

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[27] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

[28] Smith, Zachary A., and Katrina D. Taylor. *Renewable and Alternative Energy Resources.* ABC-CLIO, Inc. 2008.

[29] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Pg. 212, Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

[30] International Energy Agency. *Golden Rules for a Golden Age of Gas*. International Energy Agency, 2012. Accessed April 9, 2013. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf.

by 20% as well as the International Union for Conservation of Nature's 2012 *World Conservation Congress Resolution 90* titled 'The Exploration and Exploitation of Unconventional Fossil Fuels' which called for the prohibition of producing unconventional fuels unless there are stringent measures taken to restrict harmful development and to protect the environment.[31] These international policies face the same obstacles that U.S. national policies face against State sovereignty. The decentralized nature of power within the United States means that Congress (under the advice of the EPA) could pass policies that limit environmental degradation, but it remains up to State legislature to actually implement these national policies. E. Donald Elliot, a professor at Yale University, raises the question "Why doesn't the United States have a renewable energy policy like those in Europe?" Elliot states that "the answers lie deep in our political structure and political culture, as well as our natural endowment of huge resources of fossil energy, including shale gas and unconventional oil".[32] Mr. Hamwey and Mr. Pacini of UNCTAD stated in an interview that they viewed the energy and environmental policies within the United States as not being strong. The separation between the federal government and state government weakens the strength of policies. The problem is no one knows who to hold accountable. Is it Congress's fault that there are no lasting renewable energy policies or does it fall under the State's jurisdiction? [33]

Historically, energy policies in the US have always focused on maintaining a low price of energy supplies for consumers.[34] However, the United States has never had one single national

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[31] IUCN. *World Conservation Congress: Resolutions and Recommendations in Jeju, Republic of Korea*. Gland, Switzerland: IUCN, 2012. Accessed May 2, 2013. https://cmsdata.iucn.org/downloads/resolutions_and_recommendations___in_english.pdf.

[32] Elliott, E. Donald. *Why the United States Does Not Have a Renewable Energy Policy*. Washington D.C.: Environmental Law Institute, 2013. Accessed April 13, 2013. http://www.cov.com/files/Publication/ce0ce0e2-1d8b-4ef4-8dd9-5bffa4af86f8/Presentation/PublicationAttachment/5b91deeb-1583-46b7-a048-624472b2d90f/Why_the_United_States_Does_Not_Have_a_Renewable_Energy.

[33] Hamwey, Robert, and Henrique Pacini. Personal interview. UNCTAD, 30 April 2013.

[34] Smith, Zachary A., and Katrina D. Taylor. *Renewable and Alternative Energy Resources*. ABC-CLIO, Inc. Pg. 5, 2008.

energy policy. After the 1973 OPEC Oil Embargo, President Jimmy Carter's National Energy Plan of 1977 was enacted, but it was never fully fulfilled and was discarded in 1983 by the Reagan Administration which pledged the free flow of foreign oil into the United States for the next few decades. After the Rio Earth Summit of 1992, which called all nations to promote sustainable development and a 'green economy', the Energy Act of 1992 subsequently stipulated further development of renewable energy within the United States, but "has done nothing to mandate [a full] energy transition towards renewable energy [or fully] address the concerns of climate change".[35] This is reiterated by the 2005 Energy Act which "explicitly excluded 'fracking' from the Environmental Protection Agency's (EPA) Clean Water Act (and the Safe Drinking Water Act), a clause that has become known as the 'Cheney-Halliburton Loophole'".[36] It is evident from these few energy policies that fossil fuels are at the forefront of the United States' agenda; while renewable resources remain in the background. Thus it is not surprising that "so far unconventional gas operations in the United States have been remarkably free of restrictive regulations at federal or state levels".[37] This might change if Congress passes the 2009 Fracturing Responsibility and Awareness Chemicals (FRAC) Act which would permit the EPA to regulate hydraulic fracturing in the United States.[38] Unfortunately, there are many political hindrances opposed to regulatory actions for unconventional fuel development because shale gas is predicted to be immensely profitable for the United States.

The following sections will use the above information to elucidate the geopolitical and environmental consequences the Shale Gas Revolution will have for the future.

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[35] Ibid.

[36] Stevens, Paul. *The 'Shale Gas Revolution': Developments and Changes*. Chatham House, 2012. Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0812_stevens.pdf.

[37] Stevens, Paul. *The 'Shale Gas Revolution': Hype and Reality*. Chatham House, 2010. Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.

[38] Ibid.

PART 2: The Geopolitical Implications of the Shale Gas Revolution

Based on the aforementioned history and statistics of the Shale Gas Revolution, one of the clearest geopolitical consequences of increased domestic production in the United States is the possibility of United States "energy independence". As defined by Tim Gould, Senior Energy Analyst at the International Energy Agency, '"energy independence" must be interpreted to mean that the United States is close to meeting domestic energy need while importing only from the North American continent (Mexico and Canada).[39] The goal of this section is to understand how prospective and highly controversial "energy independence" will affect future trade relations with the Organization of Petroleum Exporting Countries (OPEC) as well as how the Shale Gas Revolution will affect renewable energy production.

There is much debate on the effects the Shale Gas Revolution in the United States will have on the global energy market. Many agencies acknowledge that the United States will become an exporter of shale gas and tight oil, but how will this affect oil market dominated by the Middle East and the natural gas market dominated by Russia? If the United States lessens its need to import foreign oil while producing enough oil and gas to export, what are the geopolitical implications?

The idea of energy independence is an elusive possibility of being free of foreign energy resources or self-sufficient. Lobbied around press rooms and congressional sessions since the Nixon Era, energy independence provides the United States with the chance to get out from under OPEC's foot (disputably). With the discovery of shale gas and tight oil, this possibility has become legitimate course of action for the United States. An article in the *New York Times*, states that, "with oil demand in the United States declining, output rising and increasing integration

[39] Gould, Tim. Personal interview. IEA, 19 April 2013.

with Canada, the United States is certainly on the way to becoming 'energy less dependent'".[40] Factually, the U.S. Energy Information Administration determines that "the net import share of total U.S. energy consumption is 9 percent in 2040; compared with 19 percent in 2011 (the share was 30 percent in 2005). U.S. dependence on imported liquid fuels continues to decline in the AEO2013 Reference case, primarily as a result of increased domestic oil [and gas] production".[41] Tim Gould, representing the views of the International Energy Agency, believes that the United States could become energy independent in the long-term future based on declining import statistics.[42] In a report done by BP Oil and Gas, they claim that "import dependency, measured as the share of demand met by net imports, increases for most major energy importers *except* the U.S. The import share of oil demand and the volume of oil imports in the U.S. will fall below 1990s levels, largely due to rising domestic shale oil production and ethanol displacing crude imports".[43] The possibility of energy independence is important because of the implications it has for international relations. In a report titled *Shale Gas-A Global Perspective*, KPMG affirms that,

> "With shale gas deposits being found in areas that previously had no exploitable gas reserves, shale gas production could turn countries that traditionally import natural gas into producers, making them more self-sufficient with domestic supplies. Shale gas could help them become more self-sufficient. On the other hand, countries that are traditional oil and gas exporters will need to react to their

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[40] Yergin, Daniel. "America's New Energy Reality." *New York Times*, June 9, 2012. Accessed April 11, 2013. http://www.nytimes.com/2012/06/10/opinion/sunday/the-new-politics-of-energy.html?pagewanted=all.

[41] United States Energy Information Administration. *Annual Energy Outlook 2013*. U.S. Energy Information Administration, 2012. Accessed April 9, 2013. http://www.eia.gov/forecasts/aeo/er/executive_summary.cfm.

[42] Gould, Tim. Personal interview. IEA, 19 April 2013.

[43] BP. *BP Energy Outlook 2030*. London: BP, 2012. Accessed April 13, 2013. http://www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/O/2012_2030_energy_outlook_booklet.pdf.

> changing markets. The resulting political issues could radically alter relations between countries. Shale gas will undoubtedly have important – and unpredictable – strategic implications on geopolitics and the energy industry. For example, the development of shale gas production in Europe and potential imports from the United States could help ease European reliance on Russian gas. Elsewhere, countries like the United States and China have traditionally depended on fuel imports from politically sensitive regions, constraining their foreign policy options. Abundant natural gas can help these countries gain security of supply, which could dramatically change their relationships with other nations. On the other hand, exporting countries like Canada – which could soon see its biggest natural gas customer transform into a competing supplier – will need to make huge investments in infrastructure to create new outlets for their excess supplies".[44]

All of these reports find that self-sufficiency and increased production means that the United States will turn the energy market on its head. The IEA sees that by 2035 the United States will be the largest producer of unconventional gas, "moving ahead of Russia with about 820 bcm of total gas production, compared to Russia's production of 785 bcm".[45] The competition that this Shale Gas Revolution will create strategic challenges for existing gas exporters (i.e. Russia, OPEC, and Canada) where the United States used to have limited ability to affect global gas prices, now the United States can easily affect market prices and security. This is a sizable increase in global market influence and power for the United States. Professor Alan Riley at the

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[44] KPMG Global Energy Institute. *Shale Gas - A Global Perspective*. KPMG International, 2011. Accessed April 9, 2013. http://www.gses.com/images/documents/shale-gas-global-perspective.pdf.

[45] International Energy Agency. *Golden Rules for a Golden Age of Gas*. International Energy Agency, 2012. Accessed April 9, 2013. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf.

City University London Law School stated in an article he wrote that, "Geopolitically, the shale revolution strengthens the United States, reduces China's energy dependence, generates a major global stimulus, which takes the Western economies off the fiscal rocks, while potentially destabilizing both the Russian Federation and Saudi Arabia".[46] These factors suggest that the consequences of energy independence for the United States are significant, but others view possible energy independence for the United States as inconsequential.

Many see the pursuit of energy independence as a moot point for the United States. For example, Dr. John Gault believes that United States "energy independence is not terribly meaningful".[47] He hypothesized that even if the U.S. was completely autarkic, the US would still care about the Middle East because the U.S. wants free flow of oil and to control oil market prices. In this increasingly globalized world, the U.S. would not back out of involvement in foreign countries just because they had the means to function autonomously. Similarly, Dr. Emily Meierding of the Graduate Institute of Geneva goes as far as to say that "there will be no energy independence for the United States".[48] Why? Dr. Meierding says that the boom in shale gas will primarily affect electricity supply. She says that the United States would still import oil from OPEC or at least from the Canadian tar sands for the automobile industry. She explicitly states that even if the United States manages to boost production of shale gas in pursuit of energy independence, we would still import foreign oil and thus there would be no dramatic change. She says that it has become a habit for the U.S. to be in the Middle East to keep oil flowing, if the United States becomes less dependent on Middle Eastern oil they would remain involved in the Middle East in order to get oil onto the market—the U.S. would become the "Mediator of the Oil

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[46] Riley, Alan. "The Shale Revolution's Shifting Geopolitics." *New York Times*, December 25, 2012. Accessed April 11, 2013. http://www.nytimes.com/2012/12/26/opinion/global/the-shale-revolutions-shifting-geopolitics.html.

[47] Gault, John. Personal interview. Geneva Graduate Institute, 22 April 2013.

[48] Meierding, Emily. Personal interview. Geneva Graduate Institute, 17 April 2013.

Market". Likewise, Mr. Gould states that even if the United States did become energy independent, the U.S. will still want to be involved in the Middle East, but security risk of imports decrease.[49] Michael A. Levi of the Council on Foreign Relations cautioned "that being self-sufficient did not mean that the country would be insulated from seesawing energy prices, since those oil prices are set by global markets".[50] Thus, the United States' primary goal, economically, is to maintain interregional stability and the uninterrupted flow of oil. Therefore, regardless of any perceived future energy independence, the United States will remain in the Middle East to maintain its political and economic leverage. The US will continue to use its presence to minimize China's influence and support its allies, like Japan. The only thing that the Shale Gas Revolution will do is increase America's leverage in the oil and gas market as an exporter.[51]

All of these perspectives on the geopolitical consequences of the Shale Gas Revolution combine into one possible prediction: the United States will continue to invest in unconventional fuels and will remain involved in international affairs regardless of lessened dependence on oil. If anything, the U.S. will become more powerful in the international energy market because they will be exporting gas and increasing financial leverage. There may be no consensus on the probability or consequences of energy independence due to the boom in shale gas, but the significance of the Shale Gas Revolution is important for future domestic and foreign policies within the United States. For example, one of the most important effects the shale gas production will have for the United States is on domestic policies for renewable energy development. The

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[49] Gould, Tim. Personal interview. IEA, 19 April 2013.

[50] Rosenthal, Elisabeth. "U.S. to Be World's Top Oil Producer in 5 Years, Report Says." *New York Times*, November 12, 2012. Accessed April 11, 2013. http://www.nytimes.com/2012/11/13/business/energy-environment/report-sees-us-as-top-oil-producer-in-5-years.html?_r=1&.

[51] Goodarzi, Jubin. Personal interview. Webster University, 24 April 2013.

following section will expand on the hypothesis that the Shale Gas Revolution will either hinder or help the development of renewable energy.

PART 3: How will Shale Gas affect Renewable Energy?

The Hindrance of Shale Gas

The Shale Gas Revolution is poised to take the stage as the newest source of domestic energy within the United States. The geopolitical consequences of this boom in unconventional fuels only adds as one offshoot of the total effects the Shale Gas Revolution will have for domestic and foreign policies. The other branch, which is as dramatically affected by the drilling of unconventional fuels as the oil market, is renewable energy. It has become evident from past energy policies previously described in the above sections that the United States is primarily focused on the profitability of fossil fuels rather than the long-term protection of the environment. Thus it is clear that the rise in unconventional fuels will hinder the development of renewable energy sources and beneficial environmental practices. This threat is emphasized by a warning given by the International Energy Agency chief economist, Fatih Birol, who stated that, "Renewable energy may be the victim of cheap [shale] gas prices if governments do not stick to their renewable support schemes… A "golden age of gas" spurred by a tripling of shale gas from "fracking" and other sources of unconventional gas by 2035 will stop renewable energy in its tracks if governments don't take action".[52] Similarly, another article from the National Geographic claims that, "shale gas will retard the growth of renewable energy's share of electricity, and push off the development of carbon capture and storage technology, needed to

[52] Harvey, Fiona. "Golden age of gas' threatens renewable energy, IEA warns." *The Guardian*, May 29, 2012. Accessed April 11, 2013. http://www.guardian.co.uk/environment/2012/may/29/gas-boom-renewables-agency-warns.

meet more ambitious policy targets, by as long as two decades".[53] In an interview with Dr. Meierding of the Geneva Graduate Institute, she states that the rise of unconventional fuels killed any policies for climate change and renewable energy. The push for funding evaporated. She says that the discovery of domestic shale gas is a huge setback for renewable energy; however local environmental resistance to "fracking" will help renewable policies be revived. She says that investment in renewable energy requires political will and public support.[54] Renewable energy is an underdeveloped source of energy that has been traditionally pushed aside as newfound fossil fuels are continuously sought. Essentially, "the expansion of shale gas would put limits on the expansion of other sources of electricity, because natural gas power plants tend to be cheaper than wind or solar".[55] KPMG International, a consulting agency for energy investment, stated in a similar report that "shale gas has the potential to displace fossil fuels in selected locations and potentially slow the development of renewable sources… Some critics suggest that the industry's focus on developing shale gas and other unconventional sources is taking attention and resources away from the development of renewables. Low-cost power generated with abundant natural gas supplies could disrupt the economic viability of wind, solar and geothermal projects. As a result, some worry that increased shale and other unconventional gas production could delay the shift to renewables by many years".[56] In an interview with the United Nations Conference on Trade and Development department on climate change and environment, both Mr. Robert Hamwey and Mr. Henrique Pacini believe that the discovery of

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[53] Inman, Mason. "Shale Gas: A Boon That Could Stunt Alternatives, Study Says." *National Geographic*, January 17, 2012. Accessed April 11, 2013. http://news.nationalgeographic.com/news/energy/2012/01/120117-shale-gas-boom-impact-on-renewables/.

[54] Meierding, Emily. Personal interview. Geneva Graduate Institute, 17 April 2013.

[55] Inman, Mason. "Shale Gas: A Boon That Could Stunt Alternatives, Study Says." *National Geographic*, January 17, 2012. Accessed April 11, 2013. http://news.nationalgeographic.com/news/energy/2012/01/120117-shale-gas-boom-impact-on-renewables/.

[56] KPMG Global Energy Institute. *Shale Gas - A Global Perspective*. KPMG International, 2011. Accessed April 9, 2013. http://www.gses.com/images/documents/shale-gas-global-perspective.pdf.

shale gas will set back renewable energy production.[57] However, Mr. Hamwey does acknowledge that shale gas and tight oil produce fewer pollutants and thus would be the better option to coal and oil. He sees that reducing carbon emissions is a top priority for nations due to climate change, but he knows that renewable energy will not be funded as long as fossil fuels are cheaper to produce. Akin to the affirmations of the abovementioned quotes, many environmentalists and pro-renewable energy policy activists see the development of shale gas as another episode of *Who Killed the Electric Car?* However, there is a flip side to this discovery of unconventional fuels: there is a possibility that the rise in unconventional fuels could pave the way for a renewable energy future.

Could Shale Gas Complement a Renewable Energy Future?

The success of renewable energy depends on the policies taken by the United States in the coming years of cheap, easy shale gas. As the United States pursues policies that would expand the production of unconventional fuels, like shale gas, it would be strategic planning to also expand renewable energy development in order to complement shale gas growth and ensure a secure energy future. This claim is expounded by the International Energy Agency which stated in their 2012 *World Energy Outlook* that,

> "While renewables may compete with gas in some cases, the two can be mutually beneficial, providing low-carbon electricity while maintaining the security of electricity systems. Renewable energy is largely a domestic source of energy (although some proportion of biofuels and other bioenergy is traded internationally). When it displaces imported fuels, it contributes to greater national energy security and directly reduces import bills, which represent a fairly

[57] Hamwey, Robert, and Henrique Pacini. Personal interview. UNCTAD, 30 April 2013.

> significant percentage of gross domestic product (GDP) in many importing countries and often contribute to a trade deficit. Biofuels have the potential to reduce these effects significantly. Moreover, greater use of renewables could indirectly put downward pressure on oil and gas prices and reduce price volatility".[58]

Likewise, Mr. Gould of the IEA does not believe that shale gas is in competition with renewable energy, although he states that shale gas is in competition with coal. He says that regardless of the Shale Gas Revolution, there has been a substantial increase in renewable energy in the last 5 years. He says this is because shale gas will, in the end, complement renewable energy due to renewable sources being rather variant (i.e. wind energy).[59] This statement aligns itself with the projections of the IEA, Exxon Mobile, and BP Outlooks which repetitively state that both renewable energy production and shale gas production are expected to grow. Exxon Mobile goes further to explain that the Shale Gas Revolution is necessary to generate power during intermittent solar and wind energy production. They also believe that it is the lesser evil of all fossil fuels because it emits the least amount of carbon dioxide when burned.[60] Correspondingly, Mr. Deviah Aiama of the International Union for Conservation of Nature (IUCN) states that "if and only if renewable energy is the end goal and renewable energy policies were clearly planned would unconventional fuels, like shale gas, be able to support development of renewable energy". Shale gas could complement wind and solar energy as a backup source during times of intermittency; however it is his view that shale gas would distract further development of

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[58] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

[59] Gould, Tim. Personal interview. IEA, 19 April 2013.

[60] ExxonMobile. *The Outlook for Energy: A View to 2040*. ExxonMobile, 2013. Accessed April 9, 2013. http://www.exxonmobil.com/Corporate/Files/news_pub_eo2013.pdf.

renewable energy without clear renewable energy policies.[61] These claims are legitimate. Shale gas production could possibly be used fulfill our energy needs while supporting renewable energy production, but these claims will only come to light if policies are enforced to make sure renewable energy is the long-term goal-- not forsaken, not forgotten in the face of "tried and true" cheap fossil fuels.

The following section of this essay will provide a broad policy recommendation for the United States. This recommendation will combine the fleshed out information of current statistics and predictions of the Shale Gas Revolution and renewable energy.

PART 4: Policy Recommendation

Fossil Fuels are a Finite Resource

Amid all the hype and excitement of possible energy independence and profitability of shale gas, a very important factor is constantly ignored. Shale gas, tight oil, and all other unconventional fuels are *fossil fuels*. They are limited in supply and limited in time. Eventually, "Peak Gas" will be reached and the United States will have to revert back to searching for alternative sources of energy. It is the most logical course of action to diversify US energy intake. Energy independence and security will only be achieved if the United States broadens the percentage of alternative energy (i.e. renewable energy) utilized. However, this is only one problem with dependence on fossil fuels; there are a number of environmental risks that production of unconventional fuels poses to biodiversity, water resources, soil, and the atmosphere.

The Effects of Drilling on the Environment

The exploitation of shale gas is severely detrimental to the environment. Hydraulic fracturing, as previously described, breaks apart the earth and degrades the soil. This degradation

[61] Aiama, Deviah. Personal interview. IUCN, 2 May 2013.

fragments the land and forested areas which kills the surrounding biodiversity and pollutes the air and water with escaped methane (CH_4).[62] Currently, the most publicized environmental impact created by shale gas drilling is on water resources. The chemicals and brackish water used to pump the natural gas from the shale leaks into the water table affecting freshwater aquifers and agricultural land. This then leads to negative human and animal health impacts. The second greatest impact is on the atmosphere. The UNEP Global Environmental Alert Service (GEAS) published an article November of 2012 that summarized the harmful effects the exploitation of unconventional fuels cause. In this article, they state that fugitive methane emissions are more potent and more destructive than carbon dioxide (CO_2); these methane emissions from "unconventional gas could lead to an increase in climate warming in a 20-year horizon and would only be comparable to coal over a 100-year time horizon".[63] Energy from shale gas is achieved through combustion, like other fossil fuels, this combustion produces CO_2, however the benefits of using shale gas is that it produces less CO_2 than oil and coal. This is what proponents of the Shale Gas Revolution acclaim, but they fail to acknowledge the unintentional methane emissions. In fact, the majority of oil and gas industries do not know the amount of 'associated gas' that is emitted during production. Overall, there are many small issues associated with initial drilling, but the larger issues arise in the long term. Constant production creates constant leaking. If these production problems continue, as is estimated by every Energy Outlook presented in this paper, then there will be severe environmental damage. However, it is in the UNEP's opinion that '"internalizing' these environmental costs in the costs of different fossil fuels would place them at a clear competitive disadvantage compared with many of their

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[62] Peduzzi, Pascal, and Ruth Harding. *Gas Fracking: Can We Safely Squeeze the Rocks?,* United Nations Environmental Programme Global Environmental Alert Service, 2012. Pg. 2, Accessed April 9, 2013. http://www.unep.org/pdf/UNEP-GEAS_NOV_2012.pdf. / IUCN. *World Conservation Congress: Resolutions and Recommendations in Jeju, Republic of Korea*. Gland, Switzerland: IUCN, 2012. Accessed May 2, 2013. https://cmsdata.iucn.org/downloads/resolutions_and_recommendations___in_english.pdf.

[63] Peduzzi, Pascal, and Ruth Harding. *Gas Fracking: Can We Safely Squeeze the Rocks?,* United Nations Environmental Programme Global Environmental Alert Service, 2012. Pg. 4, Accessed April 9, 2013. http://www.unep.org/pdf/UNEP-GEAS_NOV_2012.pdf.

renewable counterparts".[64] Similarly, Mr. Aiama of IUCN states that there are a great number of costs to producing unconventional fuels that affect biodiversity, water, and many other environmental factors. If these were taken into account, the costs of fossil fuels would outweigh the benefits of cheap, easy energy.[65] These are the few cons linked to the Shale Gas Revolution. The next section will contrast these cons against the benefits of renewable energy and promote the idea that shale gas could be used as a transition fuel for renewable energy development.

Think Long Term: The Benefits of Renewable Energy

Unlike fossil fuels, renewable energy is limitless. It is an inexhaustible source of energy that has very few negative impacts on the environment. However, "in a world where there is the serious possibility of cheap, relatively clean gas, who will commit large sums of money to expensive pieces of equipment to lower carbon emissions?" [66] In reply, it is the goal of this essay to enumerate the benefits renewable energy could provide for America's energy future. For example, Hamwey and Pacini state that there are a number of benefits for renewable energy that could be used as political incentives to promote development. First, and most publicized, is that renewable energy will be the most successful energy resource to mitigate climate change and carbon emissions. However, there are the economic benefits of being more labor intensive, and thus, create jobs. It also reduces waste and it connects more people to the energy grid because it is a 'decentralized' source of energy.[67] The IEA stated in their annual *World Energy Outlook* that "renewables have also been supported to stimulate economies, enhance energy security and

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[64] United Nations Environmental Programme. *Renewable Energy: Investing in Energy and Resource Efficiency*. UNEP, 2011. Pg. 215, Accessed April 13, 2013. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_6_RenewableEnergy.pdf.

[65] Aiama, Deviah. Personal interview. IUCN, 2 May 2013.

[66] Stevens, Paul. *The 'Shale Gas Revolution': Hype and Reality*. Chatham House, 2010. Pg. vii, Accessed April 13, 2013. http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/r_0910stevens.pdf.

[67] Hamwey, Robert, and Henrique Pacini. Personal interview. UNCTAD, 30 April 2013.

diversify energy supply".[68] These things are valued within the political system of the United States and can be simply achieved by supporting renewable energy development. In the end, renewable energy will have the same desired outcome as the Shale Gas Revolution if fully supported: it will 1) lessen US dependence on oil, 2) the US would remain in the Middle East to mediate the oil and gas market, while remaining secure in domestic production, 3) and the US would be able to export biomass and biofuel profitably and easily. It is a perfect mirror to that of the possibilities seen in shale gas development, except that it is limitless in supply and time (i.e. sustainable) and more environmentally-friendly. So what is holding this seemingly win-win option at bay? The answer lies in the political structure of policy implementation and lack of funding.

The Lack of Policy, the Lack of Funding

Lack of a cohesive renewable energy policy and lack of funding are the main inhibiters towards a sustainable energy future. This lack is only accentuated by the Shale Gas Revolution which has taken the majority of attention away from renewable energy. Hamwey and Pacini state that a possible solution is to make the Environmental Protection Agecy (EPA) more politically strong. They believe that the federal government should implement nationwide feed-in tariffs, tax rebates, carbon-trading, and information campaigns in support of renewable energy.[69] In an interview, Dr. Gault states that despite the discovery of natural gas in the US, renewable energy would still face implementation hurdles. He states that US policies for renewable energy are so variable-- spotty and erratic-- that there is no single policy for renewable energy

[68] International Energy Agency. *World Energy Outlook 2012*. Paris: International Energy Agency, 2012. Accessed April 8, 2013. http://iea.org/publications/freepublications/publication/English.pdf.

[69] Hamwey, Robert, and Henrique Pacini. Personal interview. UNCTAD, 30 April 2013.

implementation.[70] Thus, the best thing for renewable energy in the US would be to have one cohesive and consistent policy for long term implementation.

Solutions

Despite the popular rhetoric of energy independence and energy security from the boom in domestic natural gas, it should be the policy of the United States to use the Shale Gas Revolution as a transition fuel towards renewable energy. This policy should broadly cover a step-by-step transition timeline from fossil fuel development toward renewable energy development. This policy must be clear and concise with the end goal of renewable energy as the primary source of energy. Mr. Aiama of IUCN agrees that if this stipulation is met, then shale gas could provide the cushion of time needed to develop renewable energy infrastructure. He says that for renewable energy to become the primary energy resource, States would need to construct "smart grids" which could handle variable and decentralized energy production; as opposed to the current grid systems that are used to a steady constant source of centralized energy production.[71] Thus, the second thing needed to fully develop a renewable energy future is investment in infrastructure and technology. The UNEP GEAS department clearly states that the third course of action needed "if unconventional gas is used as a transition phase from carbon-based energy sources, then governments should design a plan to achieve this transition. Laws, taxes or other incentives would need to be in place to assure that a certain level of unconventional gas-related profits are reinvested in research and development on alternative sources of energy, such as solar, wind, hydropower, geothermal, tidal, and on energy-saving

[70] Gault, John. Personal interview. Geneva Graduate Institute, 22 April 2013.

[71] Aiama, Deviah. Personal interview. IUCN, 2 May 2013.

policies".[72] The following section combines these solutions into a singular policy that supports the claim that shale gas production could lead to a renewable energy future.

Policy Recommendation

The United States should use the Shale Gas Revolution as a cushion of time for the development of renewable energy infrastructure and technology. Seeing as shale gas will slowly transition the United States into energy security while having the added benefit of being the lesser evil of oil and coal, it could be easily used as a transitory fuel towards more sustainable energy resources, like wind, solar, or biofuels. Under this premise, the following policy considerations should be taken into account:

Regarding Shale Gas Production

1) It is this author's recommendation to enforce new regulations on shale gas development. The Environmental Protection Agency and State-led departments must take a regulatory role in monitoring stray methane emissions and environmental degradation caused from hydraulic fracturing. Using Forward Looking Infrared (FLIR) camera technology, these escaped emissions can be tracked and more stringent regulations can be imposed on unconventional gas industries;
2) Full disclosure regarding chemicals utilized in production of shale gas;[73]
3) In the happenstance that the surrounding environment is harmed, each industry must set aside mitigation funds (i.e. Superfund) in accordance with the *Comprehensive*

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[72] Peduzzi, Pascal, and Ruth Harding. *Gas Fracking: Can We Safely Squeeze the Rocks?,* United Nations Environmental Programme Global Environmental Alert Service, 2012. Accessed April 9, 2013. http://www.unep.org/pdf/UNEP-GEAS_NOV_2012.pdf.

[73] IUCN. *World Conservation Congress: Resolutions and Recommendations in Jeju, Republic of Korea*. Gland, Switzerland: IUCN, 2012. Accessed May 2, 2013. https://cmsdata.iucn.org/downloads/resolutions_and_recommendations___in_english.pdf.

Environmental Response, Compensation, and Liability Act of 1980 and the Polluter Pays Principle;[74]

4) Regular testing and monitoring of drinking water supplies with amendments to the Clean Water Act and Safe Drinking Water Act that includes regulations for unconventional fuel production using hydraulic fracturing;
5) Enforcement of regulations with severe penalties for failure to comply with the Golden Rules Case as described in the International Energy Agency's 2012 New Policies Scenario;[75]
6) A "carbon-tax" must by imposed on unconventional fuel industries to raise market prices and instill greater emission capturing capabilities;[76]

Regarding a Renewable Energy Future

7) Vicente Yu of South Centre states that the most important change needed is in the industrial infrastructure of the United States. For a renewable energy future, "piecemeal tactics" need to be implemented in order to modify the infrastructure of the United States from fossil fuel dependence to renewable energy—this includes changing roads, automobiles, and energy efficiency standards;[77]
8) A MIT energy study critically suggests the policy that "a renewable energy standard (RES) requiring a 25% renewable share of electric generation by 2030, and the

[74] United Nations Environmental Programme. *Renewable Energy: Investing in Energy and Resource Efficiency*. UNEP, 2011. Accessed April 13, 2013. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_6_RenewableEnergy.pdf.

[75] International Energy Agency. *Golden Rules for a Golden Age of Gas*. International Energy Agency, 2012. Accessed April 9, 2013. http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf.

[76] Luciani, Giacomo. Personal interview. Geneva Graduate Institute, 7 May 2013

[77] Yu, Vincente. Personal interview. South Centre, 7 May 2013.

retirement of 50% of current U.S. coal-fired generation capacity by 2030" be imposed within the United States in order to cut emissions;[78]

9) This paper recommends the use of incentives, like greater "Feed-In Tariffs", tax rebates, and information campaigns to promote investment in renewable energy.
10) There needs to be development subsidies to spur initial investment and research into renewable energy storage for intermittent resources like solar and wind energy.
11) Finally, there needs to be greater coherence between the federal government and state government in order to create a single national energy policy that promotes sustainable development of renewable energy.[79]

All of these points must be met in order to have a smooth transition from a fossil fuel dependent nation to a renewable energy future. It is this author's belief that the United States could use the discovery of shale gas to promote renewable energy development, but only if these recommendations are implemented in a step-by-step basis over the next 50 years.

Conclusion

Overall, this essay is meant to show the two main sides of the energy situation in the United States. The effects of the Shale Gas Revolution have been shown to pose geopolitical consequences for energy security and energy independence while also creating significant environmental implications for renewable energy and environmental degradation. In order to form a comprehensive policy outline that would use shale gas development as a stepping stone for a renewable energy future, it is important to understand the current history, policies, and

[78] Jacoby, Henry D., Francis M. O'Sullivan, and Sergey Paltsev. "The Influence of Shale Gas on U.S. Energy and Environmental Policy." *International Association for Energy Economics*, v. 1, no. 1 (2012). Accessed April 9, 2013. http://www.iaee.org/eeep/EEEP01_01_A05_Jacoby-EPUB/eeepissue.aspx.
[79] Yu, Vincente. Personal interview. South Centre, 7 May 2013.

predictions of the Shale Gas Revolution. This essay has attempted to clarify each of these subjects and as provided a plethora of current analysis on shale gas, renewable energy, and United States' goals of energy independence and international influence. The implications the Shale Gas Revolution has for energy security, economic leverage, and renewable energy have yet to be fully understood by politicians or researchers. Nevertheless, it is this author's opinion that with the combined knowledge of the geopolitical and environmental consequences, the United States could achieve lasting sustainable development if certain policies were in place to ensure a secure energy future. Shale gas is *finite*, but with its help the United States has the ability to shift the paradigm and create an infrastructure that could support an *infinite* supply of renewable energy.

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