NATURAL GAS: A GAME-CHANGER FOR CHINA-UNITED STATES ENERGY RELATIONS?

Erwin Rose*

ABSTRACT: *This study examines how current trends in the natural gas industry affect China–U.S. energy relations. The paper outlines recent developments in both markets and analyses how they might affect the bilateral dynamics. Increased gas production and consumption in both countries may reduce domestic and global demand for coal and oil, and therefore reduce some of the economic volatility, political tension, and environmental degradation associated with the other hydrocarbons. The author concludes that current trends in both countries offer an array of mutual benefits that are likely to increase energy security in China and the U.S., reduce bilateral political friction, and foster enhanced cooperation.*

*The author is an LLM candidate at the Centre for Energy, Petroleum and Mineral Law & Policy (CEPMLP), University of Dundee, UK and a Program Development Specialist at the U.S. Agency for International Development. He served as a Regional Policy Advisor for East Asia at the U.S. Department of State from 2008-2009. Mr. Rose is writing in his personal capacity and the views expressed here do not necessarily reflect those of the United States Government. Email: erwindrose@hotmail.com.

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ABBREVIATIONS

BCF	Billion Cubic Feet
BCM	Billion Cubic Meters
CBM	Coal-Bed Methane
CERA	IHS/Cambridge Energy Research Associates
CNOOC	China National Offshore Oil Corporation
CNPC	China National Petroleum Corporation
CO2	Carbon dioxide
DOE/EIA	U.S. Department of Energy/Energy Information Administration
GHG	Greenhouse Gas
IEA	International Energy Agency
LNG	Liquefied Natural Gas
MTOE	Million Tons of Oil Equivalent
SOE	State-Owned Enterprise
TCM	Trillion Cubic Meters
TPES	Total Primary Energy Supply

1. INTRODUCTION

Natural gas has usually played a supporting role in the energy story. Recently, gas has emerged from behind the scenes in the United States to the point where analysts often refer to advances in the extraction of "unconventional" sources as a "game changer".[1] Gas's profile is also rising as a way to reduce dependence upon Middle East oil and because of its relatively low level of pollutants, including carbon dioxide (CO2), compared with other fossil fuels, although it is composed primarily of methane -- the most potent greenhouse gas (GHG).

Energy and environment are playing an increasingly central role in China-U.S. relations. China and the U.S. are two of the largest and most powerful nations in terms of population, territory, military, and economics. The U.S. is the largest national economy, and China is the second largest. They account for the two highest volumes of international trade and they are the top two producers and consumers of energy. They are also the top two GHG emitters.

This study asks, *how do current trends in the natural gas industry affect China-U.S. energy relations*? The paper outlines major trends in both markets and analyses how these trends might affect the bilateral dynamic. Increased gas consumption in both countries may reduce domestic and global demand for coal and oil, and therefore reduce some of the economic volatility, political tension, and environmental degradation associated with the other hydrocarbons. Classical realist international relations theory emphasizes conflict stemming from rising demand for finite natural resources. Neoclassical realism suggests that an expanded international gas market might decrease geopolitical concerns caused by oil dependence. The theory of complex interdependence predicts that rising demand for a resource such as gas would stimulate common interests, with the potential for heightened conflict and/or cooperation. The liberal approach sees the potential for shared interests that might arise from increased trade.[2] This paper finds that current trends of increased gas

[1] Romm, J., *Climate action game changer, Part 1*, June 3, 2009, at http://climateprogress.org/2009/06/03 (last visited on May 12, 2010); IHS Cambridge Energy Research Associates (CERA), *Fueling North America's Energy Future: The Unconventional Gas Revolution and the Carbon Agenda*, 2010, p. ES-4.

[2] *See* Viotti, P. and M. Kauppi, International Relations (4th edition) (New York: Longman, 2010), pp. 42, 119,130-131, 139, 453.

production and consumption in both countries offer an array of mutual benefits and are likely to increase energy security in China and the U.S., reduce bilateral political friction and foster enhanced cooperation.

2. BACKGROUND: CHINA AND THE U.S. IN THE GLOBAL ENERGY MARKET

In 2008, China accounted for nearly 75% of global growth in primary energy consumption. China consumed 2002.5 million tons of oil equivalent (MTOE), 17.7% of the global total.[3] The U.S. consumed 2299 MTOE, 20.4% of the global total. The combined China-U.S. share of 38.1% exceeds that of any region with Asia-Pacific (including China) at 35.3%, Europe and Eurasia at 26.2%, North America (including U.S.) at 24.8%, Middle East at 5.4%, South and Central America at 5.1%, and Africa at 3.2%.[4]

In 2008, China consumed 375.7 million tons of oil (9.6% of the global total), 72.6 MTOE of natural gas (2.7%), 1,406.3 MTOE of coal (42.6%), 15.5 MTOE of nuclear energy (2.5%), and 132.4 MTOE of hydroelectricity (18.5%). For the U.S., the figures were 884.5 million tons of oil (22.5% of the global total), 600.7 MTOE of natural gas (22%), 565 MTOE of coal (17.1%), 192 MTOE of nuclear (31%), and 56.7 MTOE of hydro (7.9%).[5]

The U.S. consumed the most oil of any nation, with an amount twice that of second-ranked China; Japan placed a distant third in oil consumption with 222 MTOE. For coal consumption, China was by far the largest consumer, and the U.S. was a distant second with half that of China. The third leading coal consumer was India at 231.4 MTOE, less than half that of the U.S.[6]

At the end of 2008, the U.S. had proven gas reserves of 7 trillion cubic meters (TCM), 4% of the world total. China's reserves were 2 TCM, only 1% of the total.[7] U.S. gas production in

[3] International Energy Agency (IEA), *World Energy Outlook 2009*, p. 7.
[4] BP, *BP Statistical Review of World Energy June 2009*, pp. 2, 40.
[5] BP, *Supra* note 4 at p. 41.
[6] BP, *Ibid*.
[7] BP, *Supra* note 4 at p. 22.

2008, at 533 MTOE, 19.3% of the world total, was just under that of Russia, the global leader with 19.6%. China produced 68.5 MTOE, 2.5%. Four other countries exceeded China's share of production, both far behind Russia and the U.S., with Canada at 5.7%, Iran at 3.8%, Norway at 3.2%, and Algeria at 2.8%. Qatar and Saudi Arabia produced nearly identical levels to that of China.[8]

For gas consumption, the U.S. ranked first by far with 600.7 MTOE at 22%. Six other countries exceeded China's consumption of 72.6 MTOE at 2.7%: Russia at 13.9%, Iran at 3.9%, Canada at 3.3%, Japan and United Kingdom at 3.1% each, Germany at 2.7%.[9]

3. GAS IN THE CHINA-U.S. ENERGY PORTFOLIOS

Gas represented 3% of China's total primary energy supply (TPES) in 2007 – far below the global figure of 23%. This was also far below the importance to China of coal/peat (65.8%), oil (18.1%), and combined renewables and waste (9.9%), but a larger percentage than hydro (2.1%), nuclear (0.8%), and geothermal/solar/wind (0.3%).[10] For the U.S., gas represented 23% of TPES – the identical percentage of gas in the global energy mix. The share of gas in the U.S. TPES was significantly less than oil (38.9%) but just behind coal/peat (23.7%), and far ahead of nuclear (9.3%), combined renewables and waste (3.5%), hydro (0.9%), and geothermal/solar/wind (0.6%).[11]

Gas consumption increased dramatically in China but modestly in the U.S. since 1998. Chinese consumption went from 18.2 MTOE in 1998 to 35.7 MTOE in 2004, 62.6 in 2007 and 72.6 in 2008. In one year, 2006-2007, Chinese gas consumption shot up 23.8%.[12] Since 2000, annual average consumption in China increased 14%, driven by 20% increases in residential use and 16% increases for electricity – outstripping the annual economic growth rate and the demand increases for coal (10%), oil (8%), and hydro-nuclear (13% for the two

[8] BP, *Supra* note 4 at p. 25
[9] BP, *Supra* note 4 at p. 28
[10] IEA, at www.iea.org/stats/pdf_graphs/CNTPESPI.pdf (last visited on March 18, 2010).
[11] IEA at www.iea.org/stats/pdf_graphs/USTPESPI.pdf (last visited on March 18, 2010).
[12] Higashi, N., *Natural Gas in China: Market Evolution and Strategy*, IEA, June 2009, p. 4.

combined).[13] The corresponding figures for U.S. consumption show modest increases, from 575.3 MTOE in 1998, 577.9 in 2004, 595.4 in 2007, and 600.7 in 2008.[14]

China's proved gas reserves at the end of 2008 were 2.46 TCM. U.S. proved reserves at that time were 6.73 TCM. China produced 68.5 MTOE of gas in 2008, 9.6% more than the previous year.[15] Chinese production increased 18.3% from 2006-2007.[16] The U.S. produced 533 MTOE of gas in 2008, a 7.5% annual increase. At the end of 2008, China's reserves-to-production ratio was 32.3 while that of the U.S. was 11.6.[17]

China's first coal-bed methane (CBM) project was approved in 2001 and production is estimated at 200 million cubic meters for 2007. U.S. production of CBM grew from an insignificant level in 1998 to 51 billion cubic meters (BCM) by 2005.[18] China has not produced any shale gas, but several projects are advancing.

The significance of recent developments in shale for U.S. oil and gas supply can hardly be overstated, with natural gas comprising 15-40% of the total recoverable energy from shale deposits. U.S. shale production was nearly nonexistent as recently as 1997, but grew to 500 billion cubic feet (BCF) by 2001, surpassed 1,000 BCF in 2006 and then doubled to more than 2,000 BCF in 2008.[19] According to the U.S. Department of Energy's Energy Information Administration (DOE/EIA), at the end of 2007 "*U.S. crude oil reserves were 21 billion barrels, or roughly 2.5 percent of the amount potentially recoverable from oil shale deposits in … three States* [Colorado, Utah, and Wyoming].[20] Exploration in America's Barnett and Marcellus formations during the last few years has uncovered vast new gas deposits that have transformed the nation's balance of gas reserves.

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[13] Fridley, D., *Natural Gas in China* in J. Stern, ed., Natural Gas in Asia (2nd edition) (Oxford: Oxford University Press, 2008), p. 19.
[14] BP, *Supra* note 4 at p. 28.
[15] BP, *Supra* note 4 at pp. 22, 25.
[16] Higashi, *Supra* note 12 at p. 4.
[17] BP, *Supra* note 4 at pp. 22, 25.
[18] Fridley, *Supra* note 13 at pp. 13-14.
[19] Chu, S. (Secretary of Energy), *Meeting the Energy and Climate Challenge*, DOE/EIA, 2010 Energy Conference, April 6, 2010, at www.eia.doe.gov/conference/2010 (last visited on May 5, 2010).
[20] DOE/EIA, *Annual Energy Outlook 2009*, p. 37.

In the past few years, China has made progress in developing pipelines and liquefied natural gas (LNG) terminals to access foreign gas. China did not import or export any gas by pipeline in 2008. China relied completely upon domestic gas until it first imported LNG in 2006.[21] China imported 4.44 BCM of LNG in 2008: 3.61 from Australia, 0.25 from Egypt, 0.24 from Nigeria, 0.17 from Algeria, 0.16 from Equatorial Guinea, and 0.01 from Malaysia.[22] China did not export LNG in 2008.[23] The U.S. imported 104.4 BCM by pipeline in 2008: 103.2 from Canada and 1.21 from Mexico. The U.S. imported 9.94 BCM of LNG in 2008: 7.47 from Trinidad & Tobago, 1.56 from Egypt, 0.48 from Norway, 0.34 from Nigeria, and 0.09 from Qatar. The U.S. exported 0.97 BCM of LNG in 2008, all to Japan.[24]

Projections

A review of several projections shows that gas demand in China will outstrip supply by a range of 35-120 BCM in 2020.[25] The DOE/EIA *Annual Energy Outlook 2010* projects that China will import 37% of its gas by 2030, with supply doubling but demand going from just over 2 TCF to nearly 7 TCF. The DOE/EIA report expects China's increased imports to come primarily through LNG from Australia and the Middle East. [26]

By 2007, "unconventional" gas already represented 50% of total gas supply in the U.S., and DOE/EIA expects the percentage to grow substantially through 2030.[27] Daniel Yergin, who coined the term "the prize" for oil, released a study titled *Fueling North America's Energy Future* through IHS/Cambridge Energy Research Associates (CERA) in March 2010 and exclaimed: "This [unconventional gas extraction] is simply the most significant energy innovation so far this century. As recently as 2007 it was widely thought that natural gas was in tight supply and the U.S. was going to become a growing importer of gas. But this outlook has been turned on its head by the shale gale".[28] Advances in horizontal drilling and hydraulic fracturing, along with ample reserves and a competitive price environment, have

[21] Higashi, *Supra* note 12 at p. 4.
[22] BP, *Supra* note 4 at p. 30.
[23] *Ibid.*
[24] *Ibid.*
[25] Fridley, *Supra* note 13 at p. 43. *See* also Higashi, *Supra* note 12 at p. 23.
[26] DOE/EIA, *Annual Energy Outlook 2010*, cited in Sweetnam, G., DOE/EIA, 2010 Energy Conference.
[27] DOE/EIA, *Annual Energy Outlook 2009*, pp. 4, 37, 77.
[28] IHS CERA, *Shale Gas can be a "Game Changer" for North America's Energy Future*, News Release, March 10, 2010, at http://press.ihs.com (last visited on May 12, 2010).

led gas "to cause a paradigm shift in the fueling of North America's energy future", as Yergin's analysis concludes.[29] While 13% of the gas consumed in the U.S. in 2008 was imported, DOE/EIA projects that figure to decrease to 6% by 2035 with the rate of production outpacing a steady increase in consumption.[30]

It seems likely that this revolution may extend to China. Ample coal beds (for CBM) and shale gas basins exist. No shale gas has been produced in China yet, but media reports indicate that PetroChina and its parent China National Petroleum Corporation (CNPC), Sinopec, BP, Chevron and Shell have all made preliminary investments, that Chesapeake Energy and ExxonMobil are weighing options, and that the government is moving quickly to support exploration and development.[31]

Interests in promoting gas

China enshrined the goal of gas as 10% of total energy consumption by 2020 in both the 10th and 11th Five-Year Plans (2001-05, 2006-10). A 2009 International Energy Agency (IEA) study, *Natural Gas in China*, maintains that environmental benefits are the leading driver of Chinese gas expansion: "In order to promote the use of this 'cleaner energy' as a substitute for fuel oil and coal, the government … has been leading the development of the natural gas market in the country". The IEA report finds that the Chinese government has driven demand "through policy and regulation, and by developing infrastructure" successfully, particularly in deploying gas for urban uses, and the production of electricity and petrochemicals.[32]

The Obama Administration has demonstrated a commitment to expanding domestic exploitation of both oil and gas "as part of a comprehensive energy and climate program". At an April 2010 conference, U.S. Secretary of Energy Steven Chu maintained that DOE support nurtured the U.S. CBM and shale industries: "DOE investments have led to massive increases

[29] IHS CERA, *Fueling North America's Energy Future*, p. ES-1.
[30] DOE/EIA, *Annual Energy Outlook 2010*, cited in Sweetnam *Supra.* note 26.
[31] Petroleum Economist, *Natural gas: China embraces shale-gas partners*, February 2010. Lewis, I., *Asia assesses its shale-gas potential*, Petroleum Economist, May 2010, at www.petroleum-economist.com (last visited on May 12, 2010).
[32] Higashi, *Supra* note 12 at p. 4.

in recoverable coalbed methane and shale gas". He pointed to methane hydrates as the next possible large payoff.[33]

To what extent does gas displace oil and coal?

Increased gas consumption does not automatically imply a reduction in oil or coal. In China, the government is actively promoting gas as a substitute for coal, particularly for power generation and residential uses. However, gas has also substituted for oil in industry to some extent, particularly for petrochemicals, and China has several major urban bus systems using compressed natural gas.[34] DOE/EIA maintains that, "The current opportunities for competition between oil and natural gas are relatively small in the United States". Gas has the greatest potential to increase its share in the residential, commercial, and electric power sectors but these sectors together accounted for less than 7 percent of all U.S. petroleum consumption in 2007. According to EIA, "most petroleum consumption in the [U.S.] industrial sector … is not well suited for conversion to natural gas". In the U.S., oil is primarily used for transportation; this may be the area in which gas has the greatest potential to replace oil, but DOE/EIA's *Annual Energy Outlook 2009* believes this would be for only a very limited part of the sector – primarily buses.[35]

Gas is displacing coal much more than oil in both countries. The single greatest potential for switching to gas may be through expanding the capacity of gas-fired plants instead of coal-fired.[36] According to BP chief economist Christof Ruhl, from mid-2008 to early 2010 gas achieved rough price parity with coal.[37] At a similar price, gas's advantages over coal may prove decisive, especially the relatively low cost to build and operate gas-fired power plants and relatively low pollution.

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[33] Chu, S. (Secretary of Energy), *Meeting the Energy and Climate Challenge*, DOE/EIA, 2010 Energy Conference, April 6, 2010, at www.eia.doe.gov/conference/2010 (last visited on May 5, 2010).
[34] Higashi, *Supra.* note 12 at pp. 9-11.
[35] DOE/EIA, *Annual Energy Outlook 2009*, p. 43.
[36] Kaplan, S.M., *Displacing Coal with Generation from Existing Natural Gas-Fired Power Plants*, Congressional Research Service, January 19, 2010, at http://opencrs.com/document/R41027 (last visited on May 10, 2010).
[37] Ruhl, C., *Energy Markets: The Long and Short Term*, DOE/EIA 2010 Energy Conference, at www.eia.doe.gov/conference/2010 (last visited on May 5, 2010).

4. THE BILATERAL DYNAMIC

Both sides have heavily regulated and distorted energy markets. However, U.S.-based energy companies have probably the most extensive financial and technical capacity in the world. The scale of the growth in gas was demonstrated when ExxonMobil purchased XTO, a leader in unconventional gas, for $41 billion in 2009.[38]

China's gas sector has been nearly completely controlled by state-owned enterprises (SOEs) PetroChina, Sinopec, China National Petroleum and National Gas Corporation, and China National Offshore Oil Corporation (CNOOC), with price controls in effect. ExxonMobil and other multinationals purchased shares in the SOEs in 2000-2001 but sold all their holdings in PetroChina and SinoPec four years later.[39] Exxon Mobil and PetroChina signed an agreement worth $41 billion for the sale of LNG from Australia to China in 2009 and other partnerships are in effect. The U.S. Department of Commerce believes that China's rate of demand will encourage further market reforms, opening the door wider for U.S. and other foreign firms, "The Chinese government is continuing its efforts to create a more transparent gas environment to encourage investment by creating a gas law and appropriate downstream gas regulations".[40] Chinese firms have been unable to break into the U.S. market, with political opposition in the U.S. playing a role in CNOOC's failed attempt to acquire Unocal in 2005.

Both countries have promoted gas to meet their growing energy demand, diversify supply and reduce pollution. Compared with oil and coal, gas is much cleaner in that combustion emits relatively minimal sulfur, nitrogen oxide, and mercury, and half the CO2 of coal. China's emissions are a major cause of atmospheric brown clouds that affect much of Asia. Studies indicate that Chinese coal combustion may be the source of at least one-fourth of global mercury, 300-400,000 Chinese may die of pollution-related respiratory disease, and at least one-third of the air pollution in the west coast of the U.S. originates in China.[41] In 2007,

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[38] ExxonMobil, *Exxon Mobil Corporation and XTO Energy Inc. Announce Agreement*, News Release, December 14, 2009, at www.exxonmobil.com/Corporate/Files/news_release_20091214.pdf (last visited on May 10, 2010).
[39] Fridley, *Supra.* note 13 at pp. 37-38.
[40] U.S. Dept. of Commerce, at www.buyusa.gov/china/en/oilgas.html (last visited on May 10, 2010).
[41] Kim, J., *Transboundary Air Pollution – Will China Choke On Its Success?* Wilson Center/China Environment Forum, 2007, at www.wilsoncenter.org/topics/docs/transboundary_feb2.pdf (last visited on May 12, 2010).

China surpassed the U.S. as the leading GHG source. Together, the two countries account for more than 40% of global GHG emissions. The energy and climate nexus emerged as a central point of tension at the United Nations climate negotiations in Copenhagen in December 2009. Press reports quoted President Obama as saying to Chinese Vice Foreign Minister He Yafei: "If there is no sense of mutuality in this process, it is going to be difficult for us to ever move forward in a significant way".[42]

The bilateral *Memorandum of Understanding to Enhance Cooperation on Climate Change, Energy and Environment* signed in July 2009 does not specify a focus on gas, though it may be addressed under broader themes.[43] The rise of shale on the agenda became evident when Presidents Hu and Obama met in November 2009. Of the seven "clean energy announcements" they issued, one was a Shale Gas Resource Initiative.[44] A White House document states, "This Initiative will help reduce greenhouse gas emissions, promote energy security and create commercial opportunities for U.S. companies", and that "The United States is a leader in shale gas technology and developing shale gas resources in a way that mitigates environmental risks. Bringing this expertise to China will provide economic opportunities for both the U.S. and China, while improving energy security for both countries and combating climate change".[45] Despite often-voiced concerns about conflicting interests on energy policy, both governments are at least ostensibly treating natural gas expansion as mutually beneficial.

The 2009 IEA study concludes that China's likely increased dependency upon gas imports will encourage further activity by Chinese energy companies to secure access to foreign sources. The analysis concludes that this could lead to increased global supply and increase the symbiosis of Chinese interests with those of other energy consuming countries.[46] China's increasing reliance upon gas and oil imports, even with a shift toward gas, is exactly the type

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[42] Rapp, T. *et al*., *How China and India Sabotaged the UN Climate Summit*, Der Spiegel, May 5, 2010, at www.spiegel.de/international/world/0,1518,692861-3,00.html (last visited on May 7, 2010).
[43] *U.S.-China Memorandum of Understanding to Enhance Cooperation on Climate Change, Energy and the Environment*, July 28, 2009, at www.state.gov/r/pa/prs/ps/2009/july/126592.htm (last visited on April 4, 2010).
[44] DOE, *U.S.-China Clean Energy Announcements*, November 17, 2009, at www.energy.gov/news2009/8292.htm (last visited on April 4, 2010)
[45] The White House, Office of the Press Secretary, *U.S.-China Shale Gas Resource Initiative*, November 17, 2009, at www.energy.gov/news2009/8292.htm (last visited on April 4, 2010).
[46] Higashi, *Supra*. note 12 at p. 36.

of scenario that "realist" theory sees as increasing international tension but a "liberal" would view as having an integrative effect. However, given the dramatic expansion of domestic production in the U.S., it seems reasonable to conclude that commercial and political cooperation will increase, in which U.S.-based firms expand their presence in China, partnering with Chinese firms, to expand domestic gas production -- which could reap substantial benefits for both sides.

5. IMPLICATIONS

Gas trends are generally improving Chinese and American energy security, especially by diversifying energy sources and improving environmental quality. For the U.S., unconventional gas production is reducing the need for gas imports and thereby increasing its energy independence. Reduced demand for U.S. gas imports will lessen pressure on international gas markets, providing more supply at lower prices for China and others. China is currently facing increased dependence upon gas imports, but that could change as it expands domestic production of conventional gas, begins to exploit new extraction methods for the production of unconventional gas, and further reforms its market. Because in the U.S. gas is mostly displacing coal, U.S. gas trends will not affect international competition for oil. Gas is substituting for coal to a greater extent in China, and therefore increased Chinese gas consumption will slow the growth in Chinese oil demand and reduce pressure on international oil markets.

In terms of diversifying suppliers, and the attendant geopolitical implications, increased demand for gas could intensify China's relations with Russia in particular, as well as Central Asian gas-rich nations, both bilaterally and through the Shanghai Co-operation Organization,[47] which may weaken U.S. and NATO leverage. At the same time, increasing diversification reduces the power of any single supplier. Expanding LNG and pipeline capacity provides the potential for more Chinese gas imports from Australia in particular, as well as other Asian neighbours including Indonesia, Malaysia, Myanmar, Russia, and Turkmenistan. Perhaps most significantly, imports from Iran could become less important for China and thereby enable Sino-American interests to align more closely on one of the

[47] Higashi, *Supra*. note 12 at p. 35.

most sensitive issues in their current diplomatic relationship. Expanded use of gas instead of coal in both countries will improve local and international environmental quality by reducing emissions of sulfur dioxide, nitrogen oxide, and mercury. Displacement of coal in U.S., and coal and oil in China may bring significant short-term reductions in GHG emissions, or at least a reduction in the emission growth rate, by both countries. A key challenge for policy-makers is to sequence the short-term and large-scale benefits of gas expansion with cleaner alternatives that may be more economically and environmentally advantageous long-term, including conservation, efficiency, geothermal, hydro, solar, and wind.

Consideration of these international dynamics, U.S. leadership in unconventional gas extraction and the wealth of U.S. reserves, combined with the untapped potential in China, offers a strong logic for the U.S. public and private sectors to expand joint ventures with Chinese partners to facilitate the deployment of unconventional gas extraction technologies in China and increase China's domestic supply. Reduced dependence upon foreign oil by China and gas imports by the U.S., and lower GHG emission rates by both countries from expanded gas use, coupled with increased commercial joint ventures, should somewhat reduce the political friction associated with competition for scarce energy resources and increase the possibility of progress on climate change.

6. CONCLUSION

Access to finite energy resources is often portrayed as a zero-sum game that exacerbates tension between China and the U.S. However, this study points to the potential that the search for energy security may promote mutually beneficial bilateral interdependence and cooperation.[48] This analysis also supports the notion that environmental objectives are leading the Chinese government to expand its natural gas sector and that the U.S. has an interest to provide direct support for this effort in order to expand international energy supply and achieve sustainable development goals.[49]

[48] Andrews-Speed, P., *et al.*, The Strategic Implications of China's Energy Needs (London: The International Institute for Strategic Studies, 2002), p. 101, reaches a similar conclusion as does work by E.S. Downs and K. Lieberthal.

[49] As suggested in A. Myers Jaffe and K. Medlock, *China and Northeast Asia*, in Kalicki, J. and Goldwyn, D., ed., Energy & Security (Washington: Woodrow Wilson Center Press, 2005), p. 287.

The trends outlined here should reduce friction in the current bilateral energy relationship. Despite some of the synergies that this analysis has found, given the currently low share of gas in China's energy portfolio, its increasing dependence upon imports, and the minimal extent to which gas is reducing American oil consumption, influence upon the broader diplomatic relationship may not be apparent immediately. However, the increased fluidity of the international gas market and the potential for major increases in gas production in both countries may have significant geopolitical consequences in the next five to ten years. Since conservation, efficiency, and renewables offer both energy independence and greater environmental benefits, the most difficult policy question may be how to weigh the benefits of expanding the gas industry as opposed to non-fossil alternatives.

This study is a preliminary attempt to outline the conceptual issues regarding gas in China-U.S. relations. Further exploration in this vein could seek to quantify the extent to which gas is displacing other fossil fuels to obtain a more refined assessment of the implications. Another aspect of these issues worth pursuing is the extent to which expanded gas use may inhibit investment in efficiency and renewable sources, and what the impacts of gas use are in that context.

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