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THE SHALE REVOLUTION

AND THE NEW GEOPOLITICS OF ENERGY
BY ROBERT A. MANNING



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Atlantic Council

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Executive Summary

The shale revolution, the combination of computer-aided horizontal drilling and hydraulic fracturing known as “fracking,” already has had a profound multidimensional impact. After the breakthroughs in information technology (IT) and biotechnology, shale may be the most transformational technological change so far in the twenty-first century. This report argues that shale gas and tight oil has:

- begun to radically shift global energy markets and redraw the global energy map, forty years after the Arab oil embargo;
- dramatically shifted the outlook for US energy security and our national strategic calculus;
- altered geopolitics, making the Western Hemisphere—Canada, the United States, Mexico, Brazil—the new center of gravity for oil and gas production;
- turned the future of oil debate on its head; debate about whether or not “peak oil” has been reached is over. Now the issue is whether or not we are approaching “peak demand;”
- has altered market economics to slow the deployment of wind, solar, and nuclear energy and a transition to a post-petroleum economy; yet also reduced US greenhouse gas (GHG) emissions by displacing coal as a source of electricity;
- strengthened the US economy with cheap gas prices triggering a resurgence in US manufacturing and;
- potentially repositioned the United States vis-à-vis the Middle East and Asia.

The world supply of proven oil reserves has increased from 683 billion barrels in 1980 to 1.69 trillion barrels in 2012, largely the result of technological innovation in deep sea oil drilling and the shale revolution.¹ This happened despite a 16 million barrel per day (mb/d) increase in production over that period to the current 92 mb/d level. There is potential for an additional 49 mb/d worldwide, more than 4 mb/d in the United States in the coming decade.²

Shale Revolution: US Energy Renaissance

As the world’s largest producer of oil and gas hydrocarbons, the United States is projected to surpass

Saudi Arabia as the world’s number one oil producer by 2017 and become a net exporter by 2030.³ Oil production is now 8.7 mb/d, the highest since 1994.⁴ Natural gas production is 72 billion cubic feet per day (bcf/d), 40 percent of which is from shale.

There are currently ample natural gas reserves to meet current US demand for a hundred years. Moreover, estimates of recoverable shale gas and shale/tight oil are continuing to be revised upwards: the US Energy Information Administration (EIA) has increased its estimate of recoverable shale gas reserves from 6.2 trillion cubic feet (tcf) in 2011 to 7.3 tcf in 2013, and revised its raised estimate of recoverable tight oil by more than a factor of 10, from 32 billion barrels to 345 bbl!⁵

The diffusion of fracking technology globally to areas such as China, Australia, Central Europe, and Latin America over the coming decade may further transform the energy landscape and significantly reduce CO₂ emissions. The shift from the Persian Gulf to the Western Hemisphere as the hub of global hydrocarbon production reflects both dramatically reduced US dependency on oil imports from 60 percent in 2005 to 39 percent in 2013, and a new geography of imports.

For Europe, liquefied natural gas (LNG) exports from North Africa, the eastern Mediterranean, and the Gulf and over the longer term, shale gas production, could reduce its dependence on Russia. Poland and Ukraine have significant shale deposits and have signed exploration contracts with major US firms to develop them. If Ukraine can produce shale gas, it could help free Kyiv from Russian pressure and facilitate its integration with the European Union (EU).

Growing non-Organization of the Petroleum Exporting Countries (OPEC) production attain new levels and dilute OPEC’s ability to dictate prices. But it is a mistake, and certainly an overstatement, to talk of US energy independence. It is—and will remain—a global market for oil, with disruption anywhere impacting prices everywhere.

In fact, if OPEC has leverage in the future, it is likely to be mainly with Asian consumers. Over the past fifteen years, there has been a long-term trend of a growing

3 Elisabeth Rosenthal, “US to World’s Top Oil Producer in 5 Years, Report Says,” *New York Times*, November 12, 2012, http://www.nytimes.com/2012/11/13/business/energy-environment/report-sees-us-as-top-oil-producer-in-5-years.html?_r=0.

4 Energy Information Agency, “U.S. Crude Oil Production in 2013 Reaches Highest Level Since 1989, This Week in Petroleum,” March 12, 2014, <http://www.eia.gov/oog/info/twip/twiparch/2014/140312/twipprint.html>.

5 Energy Information Agency, *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States* (2013), <http://www.eia.gov/analysis/studies/worldshalegas/>.

1 BP Statistical Review of World Energy June 2013, http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf.

2 Leonardo Maugeri, “Oil: The Next Revolution” Discussion Paper 2012-10, Belfer Center for Science and International Affairs, Harvard Kennedy School, June 2012, <http://belfercenter.ksg.harvard.edu/publication/22144/oil.html>.

Middle East-Asia-Pacific energy nexus with some 70 percent of Middle East exports going to Asian consumers, principally, China, India, Japan, Southeast Asia; and some 70 percent of Asian oil imports coming from the Middle East.⁶

Strategic Implications of Shale Gas

The strategic implications of the shale revolution begin at home, strengthening US resilience, and bolstering the US economy and the environment in important ways. Low US natural gas prices have boosted US economic competitiveness and by extension, US comprehensive national power, and US capacity for global leadership. Energy-intensive industries such as chemical, petrochemical, cement, and steel are spawning a new “in-sourcing trend” with both US and European firms relocating industry to the United States. An additional and unexpected benefit has been that of a drop in US GHG emissions.

Geopolitical Risks and Benefits

The shale revolution already has had an important foreign policy impact. It is doubtful whether it would have been possible to impose oil export sanctions on Iran without oil prices skyrocketing and destabilizing a fragile global economy absent the surge in US oil production. But the most intriguing potential benefits likely to unfold over the coming decade will flow from the real possibility of the United States becoming a major LNG exporter and building global LNG markets. At present, LNG only accounts for about 31 percent of internationally traded gas. The prospect of US LNG exports building a natural gas spot market, reducing reliance on fixed contracts, could benefit consumers worldwide.

Strategically, gas exports would bolster the US “rebalance” in Asia. Already, a new Japanese energy briefing shown to the author by METI projects 20 percent of Japan’s gas imports coming from the United States.⁷ The US ability to bolster the energy security of Asian allies and partners would reinforce perceptions of US reliability and presence as an Asia-Pacific power.

Geopolitical Challenges

For major Middle East oil and gas exporters, as well as Russia, US shale gas and tight oil may alter the economics of gas development and of the oil market.

Shale holds promise to substantially enhance US global economic competitiveness and US foreign policy leverage globally.

In the case of Iran, the US shale revolution will complicate its efforts to develop its large gas reserves.⁸ Growing US oil production will diminish OPEC’s role in determining prices and perhaps the traditional Saudi role as the swing producer.

To date, close US-Saudi relations and a sense of antagonism have precluded cooperation between Russia and OPEC oil and gas producers. A weaker US-Saudi bond resulting from increased US energy self-sufficiency along with diverging interests in the ongoing Sunni-Shia conflict in the Islamic world could create a different set of circumstances. The implicit “security-for-oil

flows” US-Saudi bargain since 1945 may be rethought by both sides.

The Obama administration has refocused US strategic priorities on the Asia-Pacific. This suggests that the shale revolution may presage a rethinking of the US role in the Middle East. The US role as security guarantor in the Persian Gulf and guardian of the vital shipping lanes from the Strait of Hormuz to the Straits of Malacca has shaped the region’s strategic landscape for more than half a century.

One new phenomenon in regard to sealane security is the unprecedented maritime cooperation in the Horn of Africa in response to the threat of piracy. Whether this leads to a cooperative maritime regime remains to be seen.

Recommendations

To maximize the possibilities presented by the still unfolding shale revolution, the author suggests the following policy recommendations:

- The administration, in consultation with Congress, should review overall US national security strategy to better take into account the strategic implications of the country’s new energy capabilities.
- To address environmental concerns and adopt a regulatory environment where best practices are closer to the norm, President Barack Obama should, in consultation with Congress, establish a bipartisan national commission on shale development that

6 Robert A. Manning, *The Asian Energy Factor* (New York: Palgrave, 2000)

7 METI senior official, interview with author, March 2014.

8 For a discussion of geoeconomic and geopolitical shifts driven by the Shale boom, see Amy Myers Jaffe and Ed Morse, “The End of OPEC,” *Foreign Policy*, October 16, 2013, http://www.foreignpolicy.com/articles/2013/10/16/the_end_of_opec_america_energy_oil.

includes scientists, engineers, energy companies, state and federal regulators, and environmental groups to propose regulatory and policy actions for minimizing risk and harmonizing regulations based on best practices.

- The administration should revise strictures and regulatory obstacles to the export of natural gas.
- The administration, in consultation with Congress, as Senator Lisa Murkowski (R-AK) has offered, should review the architecture of US laws and regulations governing energy exports and reconsider current constraints on oil exports.
- The administration should conduct a policy review on the uses of the Strategic Petroleum Reserve (SPR) and consider its utility as a tool to set a ceiling on oil prices.
- The United States should explore with its OECD partners a restructuring of the International Energy Agency (IEA), which remains based on 1973 realities. It makes little sense for a global institution of energy consumers to exclude China and India, which are consuming more than either the United States or EU and are driving global growth in oil demand.
- In light of the reality that some 70 percent of Middle East oil is exported to Asia and some 75 percent of Asian energy imports come from the Middle East, the administration should explore burden-sharing with both European and Asian partners including India, Japan, South Korea, Association of Southeast Asian Nations (ASEAN) states, and China on sealane security, based on cooperative anti-piracy actions in the Horn of Africa.
- The EU should launch a research committee to assess US regulations, collaboration between US industry and environmental groups and whether best practices address environmental concerns. The committee should make recommendations to the European Commission about the risks and benefits of fracking in EU states.

Table of Contents ---

Introduction. 1

Shale Revolution: US Energy Renaissance. 2

Strategic Implications of Shale Gas 7

Geopolitical Risks and Benefits 8

Geopolitical Challenges 11

Conclusion 12

Recommendations 13

Introduction

Still in its early stages, the shale revolution—the combination of computer-aided horizontal drilling and hydraulic fracturing known as “fracking”—is already having a profound multidimensional impact. It is redrawing the United States and global energy landscape, reshaping world energy markets, and beginning to alter global geopolitics. Shale holds promise to substantially enhance US global economic competitiveness and US foreign policy leverage globally. But it is worth recalling just how recent a phenomenon this disruptive technology is. There are also continued questions about environmental impact that may limit or even undermine the future of shale gas and tight oil production.

In 2008, just five years ago, the shale boom was in its infancy. Most forecasters failed to anticipate its stunning rise. For example, the signature US National Intelligence Council (NIC) analysis of trends, *Global Trends 2025*, focused more on prospective big technology breakthroughs like battery storage or next generation ethanol and did not project shale’s rapid rise.¹ Shale development was so incremental, over more than two decades before it took off around 2008-09, that it was largely overlooked. Still more remarkable is the fact that despite its already important impact, only a fraction of its potential in the United States and worldwide has been realized.

Yet after the breakthroughs in information technology (IT) and biotechnology, shale may be the most transformational technological change so far in the twenty-first century. This paper argues that shale gas and tight oil has:

- begun to radically shift global energy markets and redraw the global energy map, forty years after the Arab oil embargo;
- dramatically shifted the outlook for US energy security and national strategic calculus;
- altered geopolitics, making the Western Hemisphere—Canada, the United States, Mexico, Brazil—the new center of gravity for oil and gas production;
- turned the future of oil debate on its head; debate about whether or not we have reached “peak oil” is over. Now the issue is whether “peak demand” is close to being reached;
- has altered market economics to slow the deployment of wind, solar, and nuclear energy and a transition

to a post-petroleum economy; yet also reduced US greenhouse gas (GHG) emissions by displacing coal as a source of electricity;

- strengthened the US economy with cheap gas prices triggering a resurgence in US manufacturing and;
- potentially repositioned the United States vis-à-vis the Middle East and Asia.

For many years, geologists and oil analysts debated whether recoverable oil reserves had reached their maximum point and would begin a gradual but steady decline, a theory known as “peak oil.” But developments over the past couple of decades have exposed a major flaw in the argument of those insisting that “peak oil” has been reached: geologists consistently failed to factor in technological advances. This is evident as the technology for fracking and for ever deeper offshore sea drilling continuously evolve and become widely deployed.

Indeed, the world supply of proven oil reserves increased from 683 billion barrels in 1980 to 1.69 trillion barrels in 2012, largely the result of technological innovation in deep sea oil drilling and the shale revolution.²

This happened despite a 16 million barrel per day (mb/d) increase in production over that period to the current 92 mb/d level. Some analysts suggest that there is potential for an additional 49 mb/d worldwide, more than 4 mb/d in the United States in the coming decade.³

Now, “peak demand” is being reached, possibly by the end of this decade, as a Citigroup analysis has argued. Projections for future global oil demand by 2030 range from 92 mb/d to 110 mb/d or higher. For Organization for Economic Cooperation and Development (OECD) members, particularly the United States and in Europe, demand is declining, though with the European Union’s (EU) economic recovery, the International Energy Agency (IEA) forecasts modest growth, just under 1 percent for 2014 and flat growth longer term. More stringent corporate average fuel economy (CAFE) standards in the United States, mandated to increase to 54.5 mpg by 2025 and the growing electrification of transport (e.g., plug-in hybrid and electric vehicles) lead to some projections of a 4-6 mb/d decline in US oil consumption by 2030. Such a scenario could impact prices as well as carbon dioxide (CO₂) emissions and the US trade deficit.

1 National Intelligence Council, *Global Trends 2025: A Transformed World* (November 2008), <http://fas.org/irp/nic/2025.pdf>.

2 BP Statistical Review of World Energy (June 2013), http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf.

3 Leonardo Maugeri, “Oil: The Next Revolution,” Discussion Paper 2012-10, Belfer Center for Science and International Affairs, Harvard Kennedy School, June 2012, <http://belfercenter.ksg.harvard.edu/publication/22144/oil.html>.

Shale Revolution: US Energy Renaissance

As the world's largest producer of oil and gas hydrocarbons, the United States is projected to surpass Saudi Arabia as the world's number one oil producer by 2017 and become a net exporter by 2030.⁴ Oil production is now 8.7 mb/d, the highest since 1994.⁵ Natural gas production is 72 billion cubic feet per day (bcf/d), 40 percent of which is from shale.⁶

There are currently ample natural gas reserves to meet current US demand for a hundred years. Although the shale gas phenomenon, like the Internet, is now taken for granted, the rapidity of its progress, since roughly 2008, is a useful reminder of how protracted the process of commercializing technology is and how swiftly innovation can transform reality when it achieves a commercial critical mass.

Though shale gas and tight oil production ramped up from about 2008, the technology has existed for nearly a century. It was the combined public and private partnership of government-funded research and development from the 1970s and creative wildcatting entrepreneurs aided by tax credits and oil prices in the \$85-\$100/barrel range that developed commercially viable hydraulic fracturing, directional drilling, and other gas recovery technologies that scaled up the technology and took off.⁷

Moreover, estimates of recoverable shale gas and shale/tight oil are continuing to be revised upwards: the US Energy Information Agency (EIA) has increased its estimate of recoverable shale gas reserves from 6.2 trillion cubic feet (tcf) in 2011 to 7.3 tcf in 2013 and revised its raised estimate of recoverable tight oil by more than a factor of ten, from 32 billion barrels to 345 bbl!⁸

It is also important to note that shale technology is not static: it continues to improve with recent developments cutting required amounts of water in half, improving knowledge of shale composition, and

increasing the production of shale gas and tight oil.⁹ Technology improvements will also lower production costs. Some analysts familiar with both the geology and technology related to shale gas suggest that the amount of recoverable reserves may be substantially larger by an order of magnitude. Oil prices below about \$75 a barrel are likely to slow investment in shale oil, as that price point would threaten profitability. Some energy analysts judge that oil prices may hover in the \$70 to \$95 range to 2016.

The diffusion of fracking technology globally to areas such as China, Australia, central Europe, and Latin America over the coming decade may further transform the energy landscape and significantly reduce CO₂ emissions. China, for example, is dependent on coal for roughly 70 percent of its electricity.¹⁰ This has been the case for the past quarter century despite Beijing's massive investments in renewables. China also holds larger recoverable shale gas reserves than the United States, though a difficult geology and water resource factors may limit the pace and the scope of its development. Despite major Chinese efforts to date, little progress in developing its shale reserves has occurred.¹¹ Further supporting the notion of the Americas as the new center of gravity for hydrocarbons, Argentina, Mexico, and Brazil all possess substantial recoverable shale gas resources and Venezuela possesses large-scale tar sands.¹²

Europe's Shale Prospects

For Europe, liquefied natural gas (LNG) exports from North Africa, the eastern Mediterranean, and the Gulf and, over the longer term, shale gas production could reduce its dependence on Russia and its dependence on coal. There are four on-shore shale basins in Europe: one stretching from eastern Denmark/southern Sweden to Poland and the Baltics; one from northwest England to Netherlands and northern Germany; one from southern England into the Paris Basin in France; and from Slovakia and Hungary through Romania and Bulgaria. Estimates of recoverable reserves are spotty as little test drilling has been done, but they appear roughly one-third the size of US shale reserves. Several factors impede EU shale production. First, in EU states, property ownership does not extend to mineral rights, so the possibility of

4 Elisabeth Rosenthal, "US to Be World's Top Oil Producer in 5 Years, Report Says," *New York Times*, November 12, 2012, http://www.nytimes.com/2012/11/13/business/energy-environment/report-sees-us-as-top-oil-producer-in-5-years.html?_r=0.

5 Energy Information Administration, "US Crude Oil Production in 2013 Reaches Highest Level Since 1989," *This Week in Petroleum*, March 12, 2014, <http://www.eia.gov/oog/info/twip/twiparch/2014/140312/twipprint.html>.

6 "EIA: Marcellus Accounts for 40% of US Shale Gas Production," *Oil and Gas Journal*, August 5, 2014, <http://www.ogj.com/articles/2014/08/eia-marcellus-accounts-for-40-of-us-shale-gas-production.html>.

7 For a detailed analysis of the US government role in the shale revolution see Michael Shellenberger, et al., *Where the Shale Gas Revolution Came From* (Oakland, California: Breakthrough Institute, May 2012), <http://thebreakthrough.org/index.php/programs/energy-and-climate/where-the-shale-gas-revolution-came-from>.

8 Energy Information Agency, *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States* (Washington, DC, 2013), <http://www.eia.gov/analysis/studies/worldshalegas/>.

9 Brian Westenhaus, "New Fracking Technology to Bring Huge Supplies of Oil and Gas to the Market," *Oilprice.com*, January 16, 2012, <http://oilprice.com/Energy/Natural-Gas/New-Fracking-Technology-to-Bring-Huge-Supplies-of-Oil-and-Gas-to-the-Market.html>.

10 Energy Information Administration, *China* (February 4, 2014), <http://www.eia.gov/countries/cab.cfm?fips=ch>.

11 Kate Rosow Chrisman, "Shale Gas Blooms in China, Not So Fast," *Breaking Energy*, April 9, 2014, <http://breakingenergy.com/2014/04/09/shale-gas-blooms-in-china-not-so-fast/>.

12 Energy Information Agency, "Shale Oil and Shale Gas Resources Are Globally Abundant," *Today in Energy*, June 10, 2013, <http://www.eia.gov/todayinenergy/detail.cfm?id=11611>.

“wildcatters” buying rights from property owners and swiftly fracking is precluded. European environmental concerns and fears of pollution limit public acceptance. France and Bulgaria have banned fracking.

Poland, Ukraine, and the United Kingdom (UK) are actively pursuing shale gas production. The UK has offered compensation to property owners to incentivize shale production and exploration. London’s push on shale development suggests it is looking to shale to offset the decline of North Sea production. Ironically, the UK has signed contracts with the French company Total (shale development is legally banned in France) to explore for its shale resources.¹³ Ukraine and Poland have signed exploration contracts with major US firms to develop their shale resources. If Ukraine can produce shale gas, it could help free Kyiv from Russian pressure and facilitate its integration with the EU. Only Poland has begun to produce small amounts of shale gas. Within the next two to five years, the shale gas and tight oil potential of Poland and UK should become evident.¹⁴

Western Hemisphere as Hydrocarbon Hub

Regardless of the extent to which Europe joins the shale revolution, the new center of gravity of oil and gas production is moving to the Western Hemisphere. The shift from the Persian Gulf to the Western Hemisphere as the hub of global hydrocarbon production reflects both dramatically reduced US dependency on oil imports—from 60 percent in 2005 to 39 percent in 2013—and a new geography of imports.¹⁵ The shift in global markets also reflects the reality that a growing proportion of the respective oil and gas of Gulf producers being consumed locally rather than being exported. The bulk of US imports are from the Western Hemisphere and only about 10 percent from the Persian Gulf, thus enhancing US energy security and mitigating fears of disruption.

13 For an assessment of UK shale potential see, Energy Contract Company, *UK Shale Gas—An Assessment of Production and Reserve Potential*, http://www.energy-contract.com/assets/uploads/files/Shale_Gas_Flyer.pdf.

14 David Buchan, “Can Shale Gas Transform Europe’s Energy Landscape?,” Center for European Reform, July 2013, http://www.cer.org.uk/sites/default/files/publications/attachments/pdf/2013/pbrief_buchan_shale_10july13-7645.pdf.

15 Energy Information Administration, “How Dependent Are We on Foreign Oil?,” *Energy in Brief*, May 10, 2013, http://www.eia.gov/energy_in_brief/article/foreign_oil_dependence.cfm.

Mexico’s recent landmark energy reform legislation, if effectively implemented, is likely to dramatically increase its offshore oil and gas potential as well as its shale gas reserves.

Moreover, North America is an increasingly integrated market. Mexico’s recent landmark energy reform legislation, if effectively implemented, is likely to dramatically increase its offshore oil and gas potential as well as its shale gas reserves.¹⁶ According to the EIA, Mexico boasts the world’s sixth largest shale reserves, and there is much speculation that US firms will begin to develop those reserves.¹⁷

The approval of the \$5.4 billion Keystone pipeline, through which some 830,000 b/d would make its way from Canada to the Gulf Coast, would thicken the web of regional integration. The long-awaited US Department of State environmental impact report, all eleven volumes of it released last January, eviscerated the principal arguments against it.¹⁸ The 1,700 miles pipeline, the report argued, would not “significantly exacerbate” GHG emissions.¹⁹

The obvious reason is that, as the analysis also concluded, “approval or denial of any one crude-oil transport project, including the proposed project, is unlikely to significantly impact the rate of extraction in the oil sands.”²⁰

Blocking the pipeline would have *zero* impact on oil sands production. This is the reality reflected in the US Department of State’s conclusions. In fact, the 830,000 b/d of oil that would otherwise move via the pipeline from Canada would instead simply find another route.²¹ If the oil moves on rail cars, as much Canadian tar sands oil does now, it is actually *more* of an environmental threat: the growing railcar traffic has led to increasing spills and accidents along the route through Montana.

16 David L Goldwyn, *Mexico Rising: Comprehensive Energy Reform at Last?* (Washington, DC: Atlantic Council, December 19, 2013), <http://www.atlanticcouncil.org/publications/reports/mexico-rising-comprehensive-energy-reform-at-last>.

17 Nick Miroff, “The Fracking Divide: Mexico’s Oil Frontier Beckons US drillers in Wake of New Law,” *Washington Post*, April 19, 2014, http://www.washingtonpost.com/world/the_americas/the-fracking-divide-mexicos-oil-frontier-beckons-us-drillers-in-wake-of-new-law/2014/04/19/1951ba0c-e8ff-452d-84bd-d488f730991c_story.html.

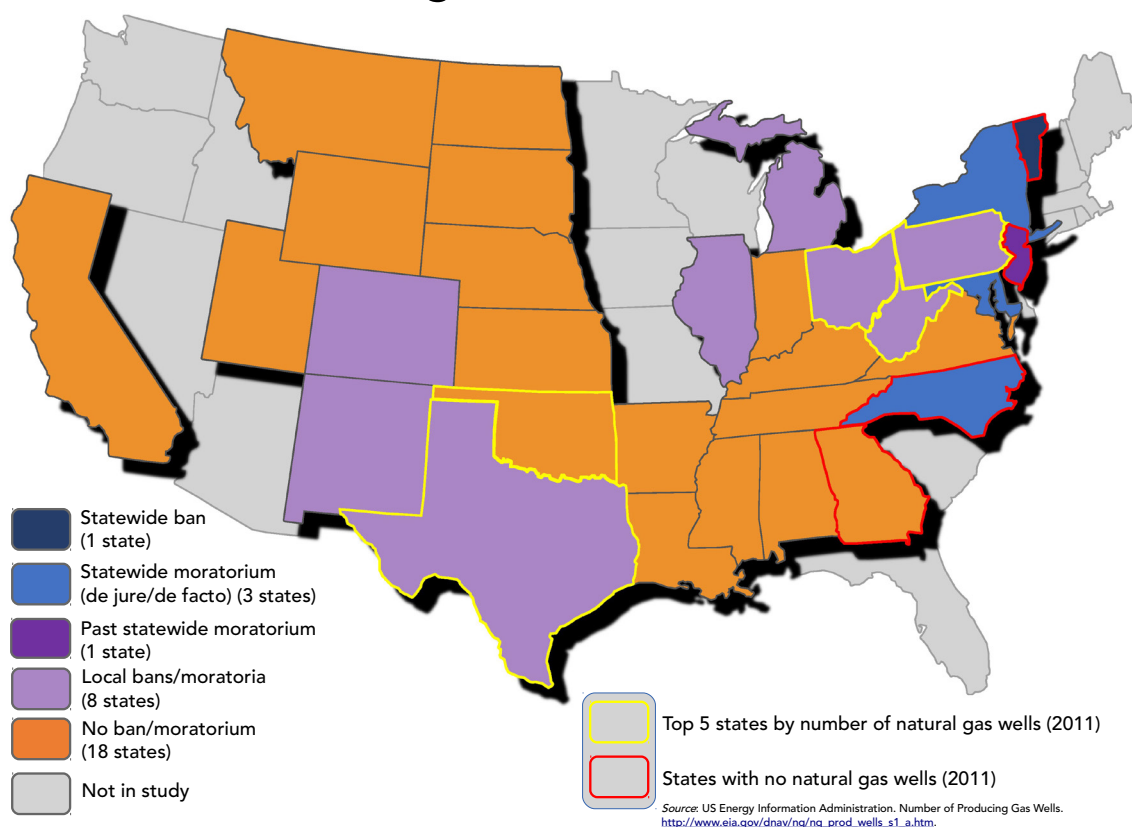
18 US Department of State, Bureau of Oceans and International Environment and Scientific Affairs, *Final Supplemental Environmental Impact Statement for the Keystone XL Project* (January 2014), <http://keystonepipeline-xl.state.gov/documents/organization/221135.pdf>.

19 Ibid.

20 Ibid.

21 Coral Davenport, “Report Opens Way to Approval for Keystone Pipeline,” *New York Times*, January 31, 2014, <http://www.nytimes.com/2014/02/01/us/politics/report-may-ease-way-to-approval-of-keystone-pipeline.html>.

Fracking Bans and Moratoria



Source: Resources for the Future (Licensed under Creative Commons).

Worse still, from a US interest perspective, absent the Keystone pipeline, there is more than a slight chance that Chinese state companies will finance a pipeline westward to Canada's coast and export the oil to China. The United States would be a double loser: it would not get roughly four thousand (temporary) jobs pipeline construction would provide and, at the same time, it would reduce North American energy integration that enhances US energy security.²² However, no decision on the Keystone pipeline is expected until after the November elections.

In any case, by the end of the decade, investments offshore in the Gulf of Mexico, offshore West and East Africa, and in Central and East Asia will likely see non-Organization of the Petroleum Exporting Countries (OPEC) production reach new levels and dilute OPEC's ability to dictate prices. Yet despite moves toward self-sufficiency, it is a mistake, and certainly an overstatement, to talk of US energy independence. The United States is—and will remain—a global market for oil, with disruption anywhere impacting prices everywhere. The free flow of oil and gas will remain a vital US interest.

But steadily declining US oil and gas imports will enhance US physical energy security and freedom of action. The new US energy situation should also lead to a reassessment of the Strategic Petroleum Reserve (SPR). If the United States is less reliant on imports and less vulnerable to disruptions, the role of the SPR could change to more proactively impact prices, not just as a means to release oil supplies during crises like Hurricane Katrina.

In fact, if OPEC has leverage in the future, it is likely to be mainly with Asian consumers. Over the past fifteen years, there has been a long-term trend of a growing Middle East-Asia-Pacific energy nexus with some 70 percent of Middle East exports going to Asian consumers—principally China, India, Japan, Southeast Asia—and some 70 percent of Asian oil imports coming from the Middle East. This has led to a growing pattern of cross-investment and burgeoning trade, with Saudi investment in refineries in China, Chinese investment in Iraq and Iran,

22 Jim Snyder, Mark Drajem, and Jim Efstathiou Jr., "Keystone XL Will Not Worsen Climate, US Says," *Bloomberg*, January 31, 2014, <http://www.bloomberg.com/news/2014-01-31/keystone-report-said-likely-to-disappoint-pipeline-foes.html>.

and Chinese consumer goods flooding the Gulf.²³ What the geopolitical significance is of this phenomenon remains unclear. One potential concern is that US Asian allies and partners may be pressured in regard to their support or lack of it for US Middle East policies.

At the same time, US exports of gas and/or oil to US allies and partners in Asia could serve as an important coping mechanism in the event of crises in the region that threaten their energy flows. Most Asian states view energy security as a vital strategic issue. Thus, US energy exports to Asia would bolster our overall posture in Asia, weaving the US more into the economic fabric of the region. The 2011 Fukushima nuclear accident in Japan, for example, has put a premium on alternative sources of electricity, as nuclear power provided 30 percent of Japan's electric power. US exports would be widely viewed in the region as an important enhancement of the US presence in the economic and security fabric of the Asia-Pacific. Thus, US energy exports would reinforce the US role as security guarantor and enhance its posture as a Pacific power.

One important caveat to these trends are some continuing environmental concerns—methane flaring, methane leaks, earthquakes, and water pollution—that could undermine the shale revolution, severely limiting its development. These environmental concerns are constraining the exploitation of major shale gas deposits in New York, Colorado, and California, all of which prohibit fracking (see box on page 6). Such concerns have also dissuaded numerous countries around the globe from developing their respective shale reserves. However, recent studies suggest that environmental concerns are manageable if best practices are widely adopted as norms by all energy companies.²⁴ Another problem limiting widespread production is the welter of differing state regulatory policies.

Long term, the principal energy challenge remains the environmental imperative to move decisively toward a more resilient post-petroleum-centered energy system. Gas should still be viewed as a critical bridging technology, though the bridge appears longer than previously thought. While low-cost US gas is triggering a shift for coal-to-gas for electricity production, it is also worsening the economics of nuclear power as well as that

of solar and wind energy. All are less cost competitive and will remain so in the near term, even as costs for solar and wind continue to fall.

One reason for viewing gas as a bridging technology, and tempering long-term projections for US tight oil production from shale, is the relatively rapid rate of exhaustion of drilled wells.²⁵ Shale production requires constant drilling of new wells because the amount derived from each individual well is relatively small, unlike in conventional fields. Already more than three million oil and gas wells have been drilled in the United States.²⁶ While there are varying estimates, ultimately factors of price and technology improvement that shape investments tend to limit the accuracy of forecasts. Projections on when production of tight oil from shale will peak and begin to level off and begin to gradually decline range from 2020 (IEA) to closer to 2030-35 (EIA). Historically, both EIA and IEA projections have tended to err on the low end. Some private sector forecasts project tight oil production growing beyond 2030.²⁷

For shale gas, growth is likely to continue into at least the 2030-2040 timeframe. This, of course, depends on the factors cited above, and not least on public acceptability, which will limit or enable shale development in places like Colorado, New York, and California. Other factors impacting shale development include global demand growth and possible breakthroughs in technology that might make renewable like solar and wind more cost-competitive, all of which are extremely difficult to anticipate.

The long-term forecasting challenge is made more poignant when one considers the demand growth for energy as the global middle class grows to as much as four billion of the eight billion estimated to be on this planet by 2030. The IEA projects global energy demand to increase by 35 to 46 percent from 2010 to 2035.²⁸ The overwhelming majority of that increased demand will come from outside OECD nations, principally from China, India, and the rest of developing Asia and Latin America. Whether the members of the emerging middle class in China, India, and Southeast Asia are driving electric cars and getting electricity from sources other than coal will determine to a large degree whether demand grows for fossil fuels or cleaner fuels less harmful for global climate change.

23 Mikal Herberg, "The New Silk Road: The Growing Asia-Middle East Energy Nexus, National Bureau of Asian Research, May 18, 2009; Erica Downs, "China-Middle East Energy Relations," testimony before the US-China Economic and Security Review Commission, June 6, 2013, <http://www.brookings.edu/research/testimony/2013/06/06-china-middle-east-energy-downs>.

24 MIT, *The Future of Natural Gas* (March 2011), <http://mitei.mit.edu/publications/reports-studies/future-natural-gas>; Grant McDermott "Hydraulic Fracking & Water Pollution," Energy Collective, April 30, 2013, <http://theenergycollective.com/grantmcdermott/218821/hydraulic-fracking>; On earthquakes, see Sharon Begley, "Study Raises New Concern About Earthquakes and Fracking Fluids," Reuters, July 12, 2013, <http://www.reuters.com/article/2013/07/12/us-science-fracking-earthquakes-idUSBRE96A0T20130712>.

25 For EIA and other forecasts, see "Future Production from US Shale or Tight Oil," Eonbrowser, <http://www.resilience.org/stories/2012-12-19/future-production-from-u-s-shale-or-tight-oil>; Mark Anthony, "The Real Natural Gas Production Decline," Seeking Alpha, <http://seekingalpha.com/article/873141-the-real-natural-gas-production-decline>.

26 Robert A. Hefner III, "The United States of Gas," *Foreign Affairs*, May-June 2014, <http://www.foreignaffairs.com/articles/141203/robert-a-hefner-iii/the-united-states-of-gas>.

27 For an IEA view, see Matthew L. Wald, "Shale's Effect on Oil Supply Is Forecast to Be Brief," *New York Times*, November 12, 2013, http://www.nytimes.com/2013/11/13/business/energy-environment/shales-effect-on-oil-supply-is-not-expected-to-last.html?_r=0. See Morse, et al., for more optimistic estimates.

28 International Energy Agency, *World Energy Outlook 2012*.

How to Save the Shale Revolution

It is not a safe assumption that the production of natural gas and tight oil from the shale revolution will be sustained or continue to expand. Festering concerns about the environmental impact of fracking—computer-aided hydraulic fracturing—and horizontal drilling threaten both the longevity and the potential scope of the shale revolution in the United States and abroad.

Legitimate apprehension over methane leaks, methane flaring, water contamination, and minor earthquakes triggered by reinjection of waste water for disposal still hover over the future of fracking. Ohio, for example, recently banned fracking in earthquake-prone areas. A number of recent studies suggest, however, that the adoption of best practices by companies engaged in fracking could ameliorate most reasonable concerns.

A steady learning curve by state regulators who shape the rules for fracking in Colorado, Wyoming, North Dakota, Ohio, and Pennsylvania, burgeoning industry-environmentalist collaboration, and continued improvements in technology together hold promise for elevating best practices to the status of new norms.

Colorado, for example, has just approved path-breaking controls on emissions from oil and natural gas (including methane), spurred by efforts of a coalition of energy firms and environmental groups. Perhaps not coincidentally, this action follows a move by five Colorado communities to ban fracking last November. The new regulations require producers to install equipment to capture 95 percent of methane gas leaks coming from wells and pipes and also limit smog-producing compounds. They also require energy producers to inspect their facilities regularly and fix leaks within fifteen days.

In Wyoming, as of March 2014, a new set of regulations went into effect requiring oil and gas companies to test wells or springs within a half mile of their drilling sites before and after drilling. The mandated rules include tests that measure temperature, bacteria, dissolved gasses such as methane and propane, nearly two dozen chemical compounds, and elements including benzene and strontium. Another Wyoming regulation took effect in 2013 requiring companies to monitor for air pollutants at oil and gas production sites and to fix any leaks. An environmental lawsuit heard earlier this year asks for disclosure of all chemicals used in fracking; current Wyoming rules on transparency require only partial disclosure. Although there is clearly increasing accountability and tighter regulation moving toward

best practices, as states are given oversight for much of the regulatory framework on fracking, the laws are uneven and vary widely from state to state. In Texas and North Dakota—the two largest oil-producing states—there are no water testing requirements. Colorado and Ohio have some requirements. Other states encourage drillers to test voluntarily. Wyoming's new law on testing may become the gold standard and foster a new norm. In addition, capturing and reusing methane on site, now done at barely 10 percent of drilling sites, is a major issue.

The challenge to gaining wider public acceptance of fracking and industry-wide practices that would answer doubters in key states like New York and California is to get beyond the inconsistent patchwork of regulations that vary widely from state to state. In 2013, in an effort to move in this direction, a coalition of energy firms and environmental groups, such as the Environmental Defense Fund, formed the Center for Sustainable Shale Development. The group is working to create voluntary standards to reduce the environmental impact of fracking.

In light of an administration that has been very late to the shale party and a dysfunctional Congress, a bit of presidential leadership could go a long way to bolstering public-private partnerships to more systematically address the whole spectrum of concerns in regard to the environmental impact of fracking.

Continuing to allow current uncertainty and ad hoc regulations (as promising as many of them are) to evolve piecemeal risks the future of fracking and all the tremendous economic benefits it has wrought. We are only a few more horror stories of polluted water, methane leaks, or earthquakes away from serious repercussions for the fracking industry. This could be avoided if industry, environmentalists, and governments pursue their enlightened self-interests.

It would not be that difficult, nor require significant budgetary or Congressional action, for the president to call governors of states with major shale reserves, energy companies, environment groups, and representatives of the scientific community to the White House with the goal of forming a stakeholders commission. This commission would examine the environmental risks, inventory and compare current regulations, and issue a set of recommendations for best practices for shale oil and gas production to govern fracking across the United States. Such an initiative could greatly strengthen public acceptance of fracking not only in the United States but also globally.

Strategic Implications of Shale Gas

The strategic implications of the shale revolution begin at home, strengthening US resilience and bolstering the US economy and the environment in important ways. The falling price of US natural gas to roughly \$4-\$5 b/cf has led to a shift from coal-fired to gas-fired power plants. Prior to the shale boom, coal accounted for 50 percent of US electricity, but plants have increasingly shifted to gas. Depending on price fluctuations, remaining coal-fired plants constitute roughly 39 percent of US electricity production while gas-fired ones provide about 32 percent.²⁹

The shift from coal to shale, combined with the economic slowdown, led to a 12 percent drop in US greenhouse gas emissions from 2007 to 2012.

This has boosted US economic competitiveness and by extension, US comprehensive national power, reinforcing US capacity for global leadership. Energy-intensive industries such as chemical, petrochemical, cement, and steel are spawning a new “in-sourcing trend” with both US firms relocating industry to the United States and many European firms also opening new American plants (in Europe average gas prices are roughly \$10-\$12 b/cf, in Japan \$16-\$18 b/cf).³⁰ For example, BASF, the German chemical firm, has earmarked \$1 billion a year to 2017 to invest in factories in the United States.³¹ A Citibank analysis estimates increased gas and oil production could add 2-3 percent to gross domestic product (GDP) by 2020.³²

It is also worth noting that the combination of an increasingly integrated and self-reliant North American energy market and continued trade and investment integration facilitated by the North American Free Trade Agreement (NAFTA) holds opportunities for additional economic growth for the United States as well as its neighbors. The ability to realize this competitive advantage for all three NAFTA economies will depend on improving border infrastructure, deepening NAFTA, and better aligning regulatory standards.³³

An additional and unexpected benefit has been that of a drop in US greenhouse gas (GHG) emissions. The shift from coal to shale, combined with the economic slowdown, led to a 12 percent drop in US GHG emissions from 2007-2012. This is a twenty-year low that achieves roughly 70 percent of Kyoto treaty goals, though the United States has not ratified the treaty.³⁴ However, as the US economic recovery has picked up, US GHG emissions have begun to increase modestly, to 2.9 percent for 2013.³⁵ The possibility of converting transport, particularly trucking and car fleets to natural gas from oil, something that is already beginning to occur, could further accelerate this trend.

29 Steven Macmillan, Alexander Antonyuk, and Hannah Schwind, *Gas to Coal Competition in the US Power Sector* (OECD/IEA, 2013), http://www.iea.org/publications/insights/coalvsfinal_web.pdf.

30 Steven Mufson, “The New Boom: Shale Gas Fueling an American Industrial Revival,” *Washington Post*, November 14, 2012, http://www.washingtonpost.com/business/economy/the-new-boom-shale-gas-fueling-an-american-industrial-revival/2012/11/14/73e5bb8e-fcf9-11e1-b153-218509a954e1_story.html.

31 William Boston, “BASF Steps Up Investment in US,” *Wall Street Journal*, December 17, 2013, <http://online.wsj.com/news/articles/SB10001424052702303949504579263903951305372>.

32 Edward L. Morse, “Energy 2020: the U.S., the New Middle East?,” Citibank GPS power point presentation, March 20, 2013.

33 For an analysis of NAFTA problems and possibilities see “NAFTA at 20: Ready to Take Off Again?,” *Economist*, January 4, 2014, <http://www.economist.com/news/briefing/21592631-two-decades-ago-north-american-free-trade-agreement-got-flying-start-then-it>.

34 Andrea Thompson, “US Gas Emissions Drop 3.8% in 2012,” Yahoo News, October 22, 2013, <http://news.yahoo.com/us-carbon-dioxide-emissions-drop-3-8-percent-141555854.html>; Julie M Carey, “Surprise Side Effect of Shale Gas Boom: A Plunge in US Greenhouse Gas Emissions,” *Forbes*, December 7, 2012, <http://www.forbes.com/sites/energysource/2012/12/07/surprise-side-effect-of-shale-gas-boom-a-plunge-in-u-s-greenhouse-gas-emissions/>; Energy Information Administration, *US Energy-Related Carbon Dioxide Emissions, 2012* (October 2013), <http://www.eia.gov/environment/emissions/carbon/>.

35 Justin Gillis, “Global Rise Reported in 2013 Greenhouse Gas Emissions,” *New York Times*, September 21, 2014, <http://www.nytimes.com/2014/09/22/science/earth/scientists-report-global-rise-in-greenhouse-gas-emissions.html>.

Geopolitical Risks and Benefits

The shale revolution already has had an important foreign policy impact. It is doubtful whether it would have been possible to impose oil export sanctions on Iran without oil prices skyrocketing and destabilizing a fragile global economy absent the surge in US oil production. More broadly, oil production disruptions that followed the Arab Awakening would almost certainly have driven prices significantly higher were it not for the boom in US oil production.

Importantly, the shale gas boom has also freed up LNG that the United States was projected to import from markets in Europe and Asia. This has increased gas supply options for the EU. It also has provided Asian LNG importers with increased available supply, though it has had only a marginal impact on prices.

But the most intriguing potential benefits likely to unfold over the coming decade will flow from the real possibility of the United States becoming a major LNG exporter and building global LNG markets. At present, LNG only accounts for about 31 percent of internationally traded gas.³⁶ The majority of gas exports is via pipelines, most under fixed, long-term contracts. There are twenty-two LNG terminals in the United States, which were built to receive imports and are in the process of being re-engineered to convert to LNG exports. US Department of Energy (DOE) has approved licenses for seven of them to date, with some fifteen pending. Over the coming decade, the prospect of US LNG exports building a natural gas spot market, reducing reliance on fixed contracts, could benefit consumers worldwide.

This prospect of LNG exports is now being debated in Congress, and already are gradually beginning to

increase.³⁷ For some twenty countries with which the United States has a Free Trade Agreement (FTA), such as South Korea, LNG exports are necessarily included. Other key allies, like Japan, must get DOE approval. Given the magnitude of shale gas reserves, concerns that gas exports would spike the domestic price of gas are overblown. A 2012 study done for the DOE concluded that gas exports would have only a modest impact on prices.³⁸

Moreover, a debate is beginning about US exports of oil as well. In several recent white papers, Senator Lisa Murkowski (R-AK) has called for modernizing the architecture of laws and regulations governing energy exports, including constraints on the export of US-produced crude oil.³⁹ Expanding exports of US gas and oil would impact global markets and reduce the US trade deficit as well as adding an important arrow to the quiver of US foreign policy leverage.

Energy exports would strongly reinforce the US position in Asia; Japan, South Korea, and Taiwan are major gas importers. China is also becoming a major importer, currently importing roughly 30 percent of its natural gas. Demand projections suggest China may import 50 percent of its gas by 2025.⁴⁰ US gas exports to

China would add a dimension of economic and strategic interdependence to the Sino-American relationship.

Strategically, gas exports would bolster the US “rebalance” in Asia. Already, a new energy briefing shown to the author by a Ministry of Economy, Trade,

Energy exports would strongly reinforce the US position in Asia; Japan, South Korea, and Taiwan are major gas importers. China is also becoming a major importer, currently importing roughly 30 percent of its natural gas.

36 BP Statistical Review of World Energy 2013, p. 28, http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf.

37 Wendy Koch, “US Natural Gas Exports Poises for Takeoff despite Debate,” *USA Today*, April 7, 2014, <http://www.usatoday.com/story/news/nation/2014/04/07/us-natural-gas-exports-to-begin/7204925/>.

38 Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets* (January 2012), <http://www.eia.gov/analysis/requests/fe/>.

39 Lisa Murkowski, “A Signal to the World: Renovating the Architecture of US Energy Exports,” US Senate, January 7, 2014, http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=546d56f0-05b6-41e6-84c1-b4c4c5efa372.

40 Michael F. Farina and Adam Wang, *China’s Age of Gas: Innovation and Change for Energy Development* (General Electric, 2013), pp. 20-22, <http://www.ge.com/cn/sites/default/files/GE-Gas-China-1015final.pdf>.



A Sailor looks on as a refueling probe pumps fuel into the ship during a replenishment at sea operation in the East China Sea. Source: Mass Communication Specialist Seaman Declan Barnes, US Navy.

and Industry (METI) official projects 20 percent of Japan's gas imports coming from the United States.⁴¹ The United States' ability to bolster the energy security of Asian allies and partners would reinforce perceptions of US reliability and presence as an Asia-Pacific power. Australia, a close US treaty ally, is another major source of Asian gas exports. The combination of US and Australian gas contributing to East Asian energy security would be an important new strategic reality.

An intriguing question is how the shale revolution will impact Russia's future. Moscow's ability to use its energy resources as an instrument of coercive diplomacy will almost certainly begin to decline. The larger question is in regard to Russia itself. With an economy still heavily dependent on oil and gas resources—30 percent of its gross domestic product (GDP), 70 percent of its exports, and 50 percent of its growth since 2000—shale gas could impact Russia in different ways.⁴²

Though oil has been in the \$100/brl range, already Russian economists forecast only 1.2 percent growth over the next several years, and the economic impact of sanctions and capital flight of Russian President Vladimir Putin's Ukraine intervention could result in -2 percent GDP growth in 2014.⁴³ One scenario is shale leading to increasing pressure on Moscow to reform and diversify and modernize its economy to become less dependent on energy resources. This is highly unlikely during Putin's rule. Another possibility is that Russia, which has substantial shale resources of its own, becomes more of a petro-state, developing its shale resources and using its large conventional gas resources to move away from "pipeline politics" toward expanding its own LNG markets. Russian firms are building two large LNG facilities in the Russian Far East and are increasingly focused on exporting to Asian markets.

41 METI senior official, interview with the author, March 2014.

42 "Oil and Natural Gas Sales Accounted for 68% of Russia's Total Export Revenues in 2013," *Today in Energy*, Energy Information Agency, July 23, 2014, <http://www.eia.gov/todayinenergy/detail.cfm?id=17231>; Leon Aaron, "The Political Economy of Russian Oil and Gas," *American Enterprise Institute*, May 29, 2013, <http://www.aei.org/outlook/foreign-and-defense-policy/regional/europe/the-political-economy-of-russian-oil-and-gas/>.

43 "An Uneven Global Recovery Continues," *World Economic Outlook Update*, International Monetary Fund, July 2014, <http://www.imf.org/external/pubs/ft/weo/2014/update/02/>.

Geopolitical Challenges

For major Middle East oil and gas exporters, as well as Russia, US shale gas and tight oil may alter the economics of gas development and of oil market dynamics. In the case of Iran, the US shale revolution will complicate its efforts to develop its large gas reserves.⁴⁴ Growing US oil production, along with increased non-OPEC oil production elsewhere, will diminish OPEC's role in determining prices over time and perhaps the traditional Saudi role as the swing producer.

The extent to which the shale revolution is a disruptive force in the Middle East is unclear. To the degree that US shale gas and tight oil lower prices, stability in Saudi Arabia and other Gulf Cooperation Council (GCC) states could be affected. As Middle East oil and gas producers consume more of their products and need high oil prices to meet their budget requirements, oil prices in the \$70-\$90/brl range, as some forecast, could spark instability. Saudi Arabia, which now consumes 25 percent of its oil production, reportedly needs in the range of \$85/brl to balance its budget.⁴⁵

To date, close US-Saudi relations have precluded cooperation between Russia and OPEC oil and gas producers. A weakening of the US-Saudi bond resulting from increased US energy self-sufficiency along with diverging interests in the ongoing Sunni-Shia conflict in the Islamic world could create a different set of circumstances. However, the effort to counter ISIS may give new impetus to US-Saudi partnership.

The implicit US-Saudi "security-for-oil" bargain, held since 1945, might be rethought by both sides considering the Saudis' distrust of the United States' recalibration of interests and a US reticence to get pulled deeper into regional politics. However, Russian support for Bashar al-Assad in Syria puts Moscow on the other side, as the Saudis and GCC states have backed the Syrian opposition, suggesting a Russian-GCC energy coalition remains a distant prospect at best. Nor are there any signs that China, despite its burgeoning role as an economic stakeholder in the region, intends to displace the US role in the Middle East.

The United States is at a historic juncture where the US public is weary after a decade of, at best, inconclusive wars in Iraq and Afghanistan. This occurs as the shale revolution has reduced US dependence on overseas energy. At the same time, the Obama administration

has refocused US strategic priorities on the Asia-Pacific. This suggests that the shale revolution may presage a rethinking of the US role in the Middle East. The US role as security guarantor in the Persian Gulf and guardian of the vital shipping lanes from the Strait of Hormuz to the Straits of Malacca has shaped the region's strategic landscape for more than half a century.

This US role has meant other major oil consumers have been largely free-riding on the US-provided stability and sea lane security. This is especially true of China, which is in the midst of building a blue water maritime capacity. One key question is whether the combination of redefined US interests, the reality of a growing Middle East-Asian energy nexus and new or enhanced naval capabilities of China, India, Japan, South Korea, and other actors results in burden-sharing by others to ensure sea lane security.

A key policy question is whether the United States and China can cooperate in the Middle East or whether a more assertive China will make such cooperation impossible, adding a new source of tension. Another factor that could reduce the US role in the Middle East is a potential rapprochement with Iran, though that still remains problematic. Some analysts suggest that a rapprochement with Iran could increase the US role in the region as a result of a more powerful Iran.⁴⁶

In any case, over time, China is likely to play a larger geopolitical role in the Middle East, as it already has in Central Asia, and in support of its oil interests in Sudan. Strategically, it can be argued that large-scale Chinese energy and infrastructure investments in pipelines, roads, and rail lines in Central Asia and its growing investment in the Gulf are indeed fashioning a new Silk Road.

One new phenomenon in regard to sea lane security is the unprecedented maritime cooperation in the Horn of Africa among all the countries mentioned above in response to the threat of piracy. In peacetime, piracy and terrorism are the principal threats to the security of energy flows in the Gulf on which the global economy is dependent. Whether the anti-piracy cooperation in the Horn of Africa is an anomaly or a precedent that could lead to a cooperative maritime regime remains to be seen.

44 For a discussion of geoeconomic and geopolitical shifts driven by the shale boom, see Amy Myers Jaffe and Ed Morse, "The End of OPEC," *Foreign Policy*, October 16, 2013, http://www.foreignpolicy.com/articles/2013/10/16/the_end_of_opec_america_energy_oil.

45 "Saudi Arabia Needs \$85/b Brent to Balance Budget as Oil Output Falls: Jadwa" Platts, December 24, 2013, <http://www.platts.com/latest-news/oil/dubai/saudi-arabia-needs-85b-brent-to-balance-budget-21992779>.

46 David H. Petraeus and Vincent Serchuck, "The US Needs to Plan for the Day After an Iran Deal," *Washington Post*, April 9, 2014, http://www.washingtonpost.com/opinions/us-needs-to-plan-for-the-day-after-an-iran-deal/2014/04/09/056ff992-bf4b-11e3-b195-dd0c1174052c_story.html.

Conclusion

There are clearly more questions than answers about the strategic consequences of the shale revolution. Although much attention has been focused on the economic and environmental impact of the shale revolution, comparatively little thought has been given to the national security consequences. The US energy situation has been transformed with ramifications rippling across the US economy. The shale revolution opens up a range of new choices for US foreign policy. Certainly, the growing move toward self-sufficiency gives the United States more flexibility in its foreign policy choices.

The new energy realities the United States has created could lead US foreign policy in different directions. One path is more isolationist, pulling back from current global responsibilities and focusing inward on American renewal. But the increase in US national power could also lead to a more interventionist international posture. The current national mood, as reflected in a number of opinion polls, if not isolationist, is one for more cautious engagement.⁴⁷

It is hard to imagine that support for greater US involvement in a Middle East that looks to be undergoing a generation-long quest for modernity is likely. This may already be reflected in the Obama administration's cautious approach to the military non-coup in Egypt and its reticence to intervene in Syria. Yet the United States will be mindful of the reality of a global oil market and the dearth of alternatives to American leadership.

As the United States adapts energy and foreign policies to the new realities shaped by the shale revolution there will be a process of situation-specific trial-and-error. Future US administrations will need to discern where newfound American leverage can usefully be applied, where the limits of US influence lie, and how to redesign laws and regulatory policies governing energy exports.

But over the coming decade, as indicated above, the shale revolution is likely to impact Russia's choices about its future and, in the process, US-Russian relations. It also is likely to reinforce the US "rebalance" in the Asia-Pacific. Whether China and other Asian actors see their interests (at least in peace time) aligned closely enough to cooperate in sea lane security is an open question. Over time, the shale revolution may well be viewed as an inflection point marking an era of American resurgence.

⁴⁷ Pew Research Center, *America's Place in the World 2013* (December 2013), <http://www.people-press.org/2013/12/03/public-sees-u-s-power-declining-as-support-for-global-engagement-slips/>.

Recommendations

To maximize the possibilities presented by the still unfolding shale revolution, the author suggests the following policy recommendations:

- 1** The administration, in consultation with Congress, should review overall US national security strategy to better take into account the strategic implications of the country's new energy capabilities.
- 2** To address environmental concerns and adopt a regulatory environment where best practices are closer to the norm, Obama should, in consultation with Congress, establish a bipartisan national commission on shale development that includes scientists, engineers, energy companies, state and federal regulators, and environmental groups to propose regulatory and policy actions for minimizing risk and harmonizing regulations based on best practices.
- 3** The administration should revise strictures and regulatory obstacles to the export of natural gas.
- 4** The administration, in consultation with Congress, should review the architecture of US laws and regulations governing energy exports and reconsider current constraints on oil exports.
- 5** The administration should conduct a policy review on the uses of the Strategic Petroleum Reserve (SPR) and consider its utility as a tool to set a ceiling on oil prices.
- 6** The United States should explore with its OECD partners a restructuring of the IEA, which remains based on 1973 realities. It makes little sense for a global institution of energy consumers to exclude China and India, which are consuming more than either the United States or EU and are driving global growth in oil demand.
- 7** In light of the reality that some 70 percent of Middle East oil is exported to Asia and some 75 percent of Asian energy imports come from the Middle East, the administration should explore burden-sharing with both European and Asian partners including India, Japan, South Korea, Association of Southeast Asian Nations (ASEAN) states, and China on sea-lane security, based on cooperative anti-piracy actions in the Horn of Africa.
- 8** The EU should launch a research committee to assess US regulations, collaboration between US industry and environmental groups, and whether best practices address environmental concerns. The committee should make recommendations to the European Commission about the risks and benefits of fracking in EU states.

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