Center for American Progress

U.S. Natural-Gas Use Must Peak by 2030

Darryl Banks and Gwynne Taraska July 2013

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COVER PHOTO
In this March 29, 2013 file photo, a worker switches well heads during a short pause in the water pumping phase, at the site of a natural gas hydraulic fracturing and extraction operation outside Rifle, in western Colorado.

AP PHOTO/BRENNAN LINSLEY

Contents

Introduction and summary

The impacts of climate change are already occurring: There were 25 climate-related extreme weather events in the United States in the period from 2011 to 2012 that each caused at least $1 billion in damages.[1] Fortunately, U.S. carbon pollution from energy consumption is at its lowest point since 1994, in part because electricity generation by natural gas is replacing electricity generation by coal.[2] The modern fuel-economy standards issued by the Obama administration have reduced emissions as well. Nonetheless, the U.S. Energy Information Administration, or EIA, predicts that U.S. carbon pollution will begin to rise again by the end of this decade.

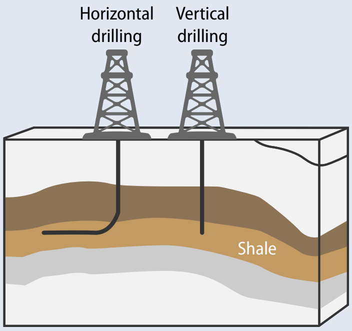
The United States is currently experiencing a boom in natural-gas production and use due to advances in drilling and extraction technologies. Because natural gas burns more cleanly than other fossil fuels and is currently affordable and abundant, it has been celebrated as a so-called bridge to a clean energy future and climate stabilization.[3] In this scenario, natural gas would significantly displace coal in the electric-power sector, which is the largest sector in terms of primary energy consumption,[4] and serve to balance more intermittent renewable sources of energy while we develop and deploy zero-carbon electricity systems.

This report finds that natural gas has an important role to play in achieving the emissions reductions necessary to stabilize the climate and prevent the worst impacts of global warming. In the near term, natural gas presents opportunities to reduce carbon pollution insofar as it burns more cleanly than coal and can be used to significantly replace coal in the generation of electricity. It also presents opportunities in the transportation sector, as natural-gas vehicles are a cleaner alternative to traditional vehicles and increasingly are being used in both private and public fleets.[5] In addition, the natural-gas expansion may present some near-term economic benefits for middle- and lower-income Americans by creating jobs and stimulating the manufacturing sector.

Terminology

Horizontal drilling

This is the process of drilling a well that curves and then extends into the reservoir horizontally. Horizontal drilling allows more of the reservoir rock to come into contact with the wellbore, or the drilled hole, compared to traditional vertical drilling.[6]



Hydraulic fracturing, or "fracking"

Fracking is a technique of gas or oil extraction in which a large amount of chemical-laced water is injected at high pressure into the wellbore, which creates and expands cracks in subterranean rock.[7] Each fracking project uses approximately 2 million to 4 million gallons of water.[8] Proppants, which contain sand or ceramic spheres, are injected to hold open the fractures so that gas can flow to the surface.[9]

Shale gas

Shale gas is natural gas found in formations of shale, which is a fine sedimentary rock. Horizontal drilling and fracking have made it possible and economical to extract natural gas from shale formations.

Dry versus wet natural gas

Natural gas is considered "dry" when it is nearly pure methane. "Wet" natural gas contains other hydrocarbon compounds as well, such as butane and ethane. These are separated from the methane before natural gas is sent to consumers.[10] Wet gas is considered more valuable, as the separated hydrocarbon compounds can be sold in addition to the methane.

Liquefied natural gas, or LNG

LNG is natural gas that has been liquefied by being cooled to approximately -161 degrees Celsius. The volume of LNG is approximately 1/600 of the volume of natural gas in its gaseous state, which facilitates transport.[11]

Fugitive methane emissions

Natural gas consists primarily of methane, which lasts for only 12 years in the atmosphere but is a potent greenhouse gas.[12] Compared on a pound-for-pound basis with CO_2, methane traps 72 times as much heat over a 20-year timeframe.[13] Throughout the lifecycle of natural gas, from drilling to end use, methane leaks into the atmosphere. These emissions are called fugitive methane emissions.

Carbon capture and sequestration, or CCS

CCS technologies capture CO_2 for storage or reuse. The allure of CCS is that it could be applied to fossil-fuel-powered electricity plants to dramatically reduce CO_2 emissions. There are a number of techniques for capture, including exposing combustion-exhaust gas to an amine- or ammonia-based solution that absorbs CO_2. No large-scale CCS projects are currently operational in the United States.[14]

Flowback wastewater, or "flowback"

Flowback is the fracking water that returns to the surface. It is contaminated not only with the original chemical additives, but also with elements extracted from the shale such as radium or barium.[15] In Marcellus shale, for example, it is estimated that 25 percent to 100 percent of the fracking fluid may return to the surface as flowback.[16] Flowback is stored in tanks or lined pits before it is either treated and recycled for use in another well or disposed of in deep injection wells.[17]

Beyond the near term, however, there needs to be a swift transition from natural gas to zero-carbon energy, particularly in the generation of electricity. Because the combustion of natural gas produces carbon pollution, albeit less than coal, too much reliance on natural gas over the long term would make it difficult or impossible to meet climate-stabilization targets. Failure to stabilize the climate would increase the frequency and severity of extreme weather events, which have been shown to disproportionately harm middle- and lower-income Americans, and the tremendous cost of disaster relief would erode any short-term economic benefits of the natural-gas boom.[18] In addition, heavy investment in natural-gas generation capacity could crowd out investments in long-term solutions such as wind, solar, wave, and other renewable electricity sources. A rapid shift from natural gas to zero-carbon energy is therefore critical. Our analysis finds that the use of natural gas must peak no later than 17 years from now, in 2030—which is sooner than many policymakers currently realize is necessary—if the United States is to meet its climate goals and avoid the worst impacts of global warming.[19]

There needs to be a swift transition from natural gas to zero-carbon energy.

The use of natural gas must peak no later than 17 years from now, in 2030—which is sooner than many policymakers currently realize is necessary—if the United States is to meet its climate goals and avoid the worst impacts of global warming.

The expansion of natural-gas production should be consistent with four key principles designed to protect public health, the climate, the middle class, and our overall economy. We recommend federal and state policies that will help to realize them.

- There needs to be a swift transition from coal to a zero-carbon future by ensuring that the use of natural gas, particularly in the electric-power sector, peaks within the next 7 years to 17 years.
- The natural-gas expansion must be managed in an environmentally sustainable manner.
- The expansion of natural gas should be used to create dedicated revenues to support aggressive investments in research, development, and deployment of clean energy technologies; aggressive investments in energy efficiency; and investments in the resilience of communities threatened by climate-related extreme weather. That is, the expansion of natural gas should be used to create a financial bridge to a zero-carbon economy and climate stabilization.
- Measures should be adopted to protect middle-class families and manufacturing companies from any price increases that may result from liquefied natural gas, or LNG, exports.

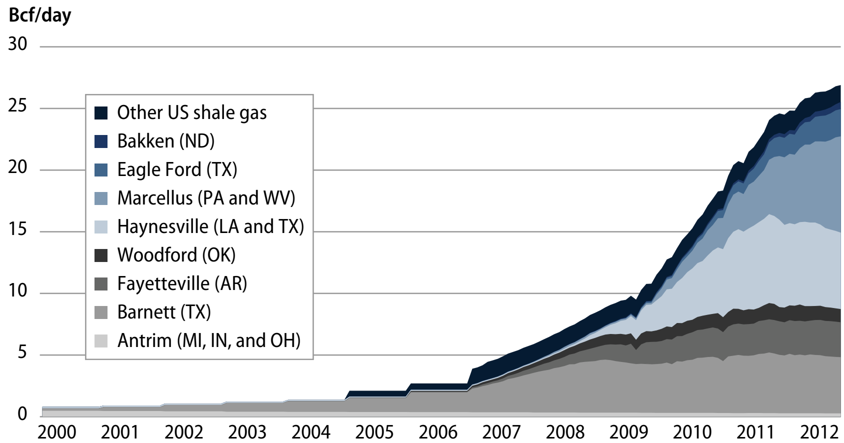
This report covers some background information about natural gas and climate stabilization and articulates detailed policy proposals that meet the above principles.

The natural-gas expansion

Recent advancements in horizontal drilling and hydraulic fracturing have unlocked a large supply of shale gas.[20] (see Figure 1) The result has been a boom in the production and consumption of natural gas. According to data from EIA, the production of dry natural gas in the United States increased 33 percent between 2005 and 2012, and the consumption of natural gas in the United States increased 16 percent during the same period.[21] (see Figures 2 and 3) The increase in domestic consumption of natural gas has been driven largely by increased consumption from the electric-power sector, which is the largest primary energy-consuming sector.

FIGURE 1

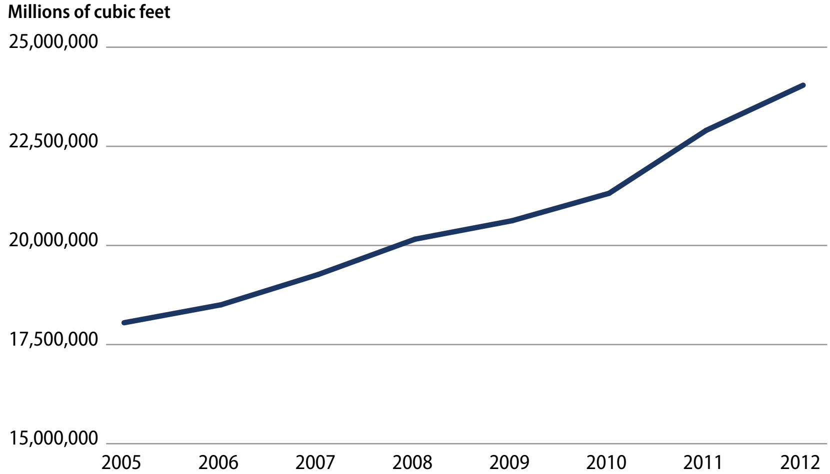
Shale production



Source: U.S. Energy Information Administration, "Energy in Brief: What is shale gas and why is it important?", available at http://www.eia.gov/energy_in_brief/article/about_shale_gas.cfm (last accessed July 2013).

FIGURE 2

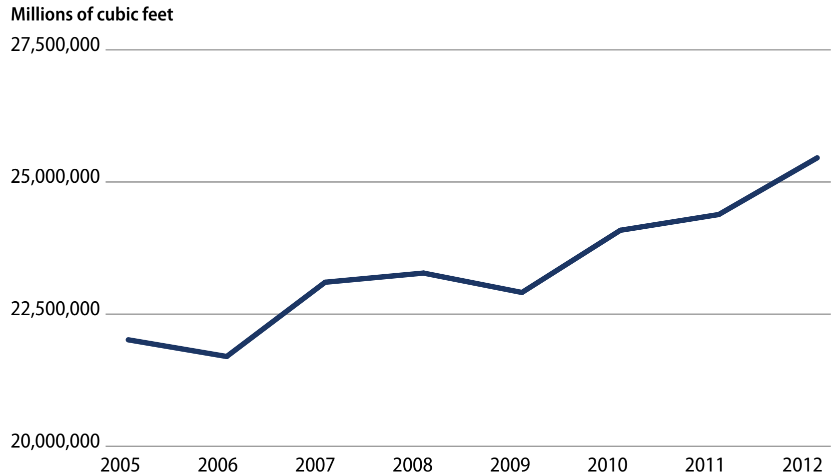
Dry natural-gas production



Source: U.S. Energy Information Administration, "U.S. Dry Natural Gas Production," available at http://www.eia.gov/dnav/ng/hist/n9070us2A.htm (last accessed July 2013).

FIGURE 3

Natural-gas total consumption



Source: U.S. Energy Information Administration, "U.S. Natural Gas Total Consumption," available at http://www.eia.gov/dnav/ng/hist/n9140us2m.htm (last accessed July 2013).

Short-term benefits from natural-gas expansion

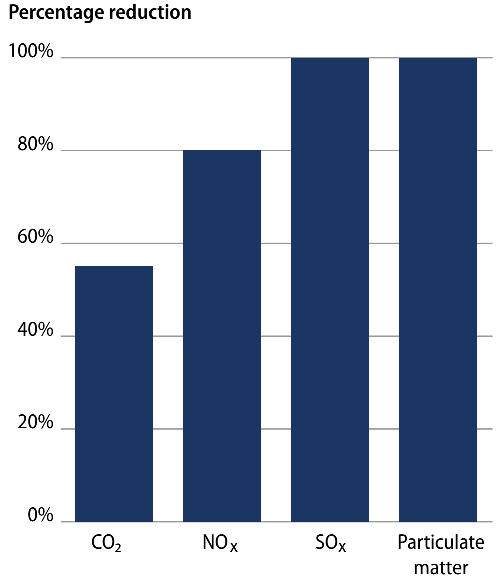
Natural gas has several environmental and economic benefits. First, its combustion for electricity is cleaner than coal. Natural-gas plants, for example, emit 55 percent less carbon dioxide, 80 percent less nitrogen oxides, and 100 percent less sulfur oxides, mercury, other heavy metals, and particulate matter than coal plants. (see Figure 4)

Given that natural gas has the potential to significantly reduce the domestic consumption of coal, which has declined from 2010 through 2012, it could result in a short-term reduction in carbon pollution.[22] Both EIA and the U.S. Environmental Protection Agency, or EPA, have credited coal-to-natural-gas switching in electricity generation as being partly responsible for recent declines in CO_2 emissions from fossil-fuel combustion.[23] Emissions decreased 6.85 percent from 2005 to 2011.[24] The Obama administration's target is a 17 percent reduction from 2005 to 2020.

Second, natural gas is currently affordable. As prices of natural gas have declined (see Figure 5), natural-gas-fired electricity generators have become more competitive with coal-fired generators. Electricity generation by natural gas and coal actually drew equal briefly in 2012 (see Figure 6) due to a steep decline in the price of natural gas in the preceding months.[25] A note of caution is that the price of natural gas has been climbing from the recent low of April 2012. (see Figure 5) The Henry Hub Natural Gas Spot Price was $4.17 per 1 million BTUs in April 2013. Another note of caution is that the low price of gas is due primarily to the boom in fracking, which has led to a dramatic increase in the supply of natural gas. This could result in large costs because of environmental externalities, which we discuss below.

FIGURE 4

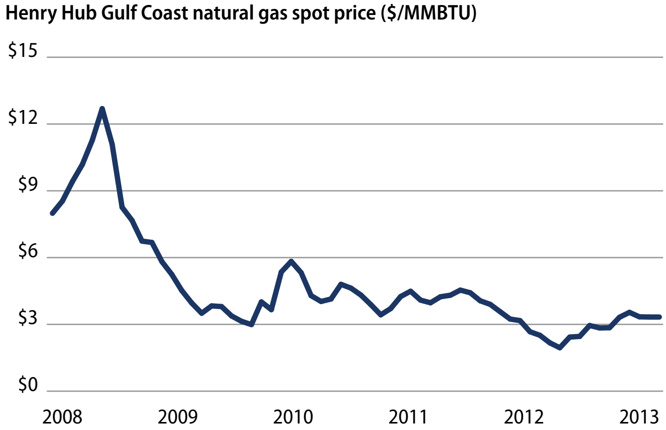
Transitoning from coal to natural gas is partly responsible for declines in CO_2 emissions



Source: Deutsche Bank Group, "Natural Gas and Renewables: A Secure Low Carbon Future Energy Plan for the United States" (2010), available at http://www.dbcca.com/dbcca/EN/_media/NaturalGasAndRenewables.pdf.

FIGURE 5

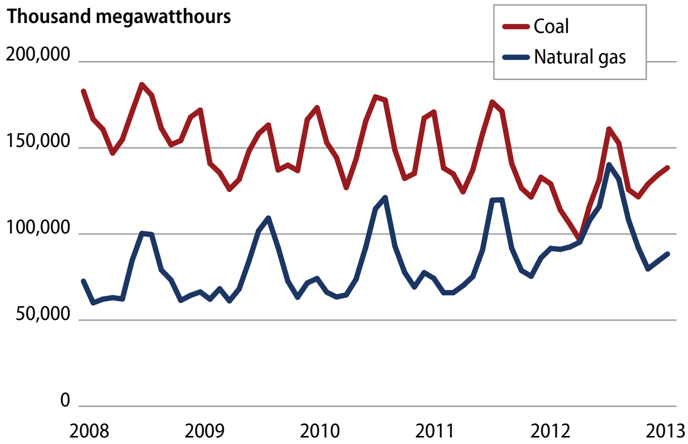
Henry Hub spot prices



Source: U.S. Energy Information Administration, "Henry Hub Gulf Coast Natural Gas Spot Price," available at http://www.eia.gov/dnav/ng/hist/rngwhhdd.htm (last accessed July 2013).

FIGURE 6

Coal and natural-gas electricity generation



Source: U.S. Energy Information Administration, "Electricity Data Browser: Net Generation for All Sectors, Monthly," available at http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vvg&geo=g&sec=g&freq=M&start=200801&end=201301&ctype=linechart&ltype=pin&pin=&rse=0&maptype=0 (last accessed July 2013).

It is commonly claimed that the recent affordability of natural gas has contributed to the revitalization of the manufacturing industry and the creation of new manufacturing jobs in the United States.[26] According to the Bureau of Labor Statistics, approximately half a million manufacturing jobs have been created from January 2010 to January 2013.[27] Other factors are likely responsible for this uptick as well, such as the narrowing gap between labor costs in the United States and China, the rising productivity of U.S. workers, and the cyclical upturn of the economy after the recession.[28]

In addition, it is claimed that the production of natural gas is adding hundreds of thousands of jobs to the U.S. economy. President Barack Obama, in his 2012 State of the Union address, estimated that shale-gas development would support more than 600,000 jobs by 2020 directly in gas production as well as in upstream and downstream manufacturing, construction, and other industries throughout the economy.[29] This number was derived from a report prepared by IHS Global Insight for America's Natural Gas Alliance.[30]

Because of these environmental and economic advantages, natural gas has been heralded as a bridge fuel. The idea is that natural gas can replace coal in the relatively near term—given that it is comparatively clean and currently available and affordable—as we ramp up renewable energy and energy efficiency and transition to a low-carbon economy. Natural gas could thus carry us from an economy that relies on high-carbon fossil fuels to an economy that relies on a cleaner energy mix.

Short- and long-term environmental and economic problems with natural-gas expansion

Despite these short-term benefits, unrestrained natural-gas expansion can create a number of problems. First, the production of shale gas by hydraulic fracturing poses potentially serious risks to local environments and communities.[31] It uses toxic chemicals, such as benzene and formaldehyde, and therefore has the potential to contaminate surface water and groundwater. It also releases smog-forming pollutants and can disrupt local ecosystems with its infrastructure of roads and pipelines. The Center for American Progress described a number of cases of air pollution, water pollution, and habitat destruction near fracking sites in a 2011 issue brief.[32] It has also reported on the direct link between earthquakes and the injection of wastewater underground.[33]

Second, natural gas consists primarily of methane, which is a powerful greenhouse gas.[34] Methane traps 72 times as much heat as CO_2 over a 20-year timeframe.[35] Throughout the entire lifecycle of natural gas—from drilling to transport to end use—methane leaks into the atmosphere. These fugitive methane emissions could offset some of the emissions reductions of coal-to-natural-gas switching. According to Ramón A. Alvarez and others, new natural-gas plants have emissions benefits compared to new coal plants—over all time frames—if the methane leakage rate is below 3.2 percent from well-to-power-plant delivery.[36] Recent estimates of the lifecycle leakage rate range from less than 1 percent to 7.9 percent.[37] The current 2013 EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks puts methane leakage at 1.4 percent.[38] The Environmental Defense Fund and a number of oil and gas companies are currently conducting a series of studies to determine fugitive methane emissions.[39] While the extent of leakage from natural-gas operations is not yet settled, fugitive methane emissions pose a serious threat to the climate and should be reduced as much as possible.[40]

Third, and the crux of this report, is that any long-term expansion and dependence on natural gas for electricity generation is incompatible with climate-stabilization targets because it also results in carbon pollution, although less than coal. The increase in global temperature must be kept within 2 degrees Celsius above preindustrial levels, which means that the concentration of atmospheric greenhouse gas must be stabilized within 450 parts per million, or ppm, CO_2 equivalent by 2050.[41] This is the internationally recognized threshold, which was adopted in 2010 at the 16th session of the Conference of the Parties to the U.N. Framework Convention on Climate Change. Exceeding the 2 degree threshold would cause severe and frequent droughts, heat waves, floods, and storms, and lower-income households would be harmed the most, as they are less able to prepare for and recover from climate disasters.[42]

In addition, failure to stabilize the climate would be tremendously costly over the long term and would erode the short-term economic benefits from the natural-gas boom. The federal government already has spent nearly $136 billion from 2011 to 2013 on climate-related disaster relief, which amounts to nearly $400 per household per year.[43] Without climate stabilization, these costs would rise exponentially.

In an effort to keep the temperature increase below 2 degrees Celsius, the Obama administration has set a series of emissions-reduction targets, relative to 2005 levels.

- A reduction of 17 percent by 2020
- A reduction of 42 percent by 2030 as an intermediate target
- A reduction of 80 percent by 2050 for climate stabilization[44]

The administration's emissions target for 2030—a 42 percent economywide reduction below 2005 levels—translates to an emissions target of 3,334.3 million metric tons, or mmt, of CO_2 from the combustion of fossil fuels (coal, oil, and natural gas).[45] This is a modest level of emissions reductions; the Intergovernmental Panel on Climate Change, or IPCC, endorses a significantly more ambitious target of 25 percent to 40 percent below 1990 levels by 2020.[46]

In the most recent set of data released by EPA, total domestic CO_2 emissions were 5,612.9 mmt in 2011, with 5,277.2 mmt of those CO_2 emissions coming from the combustion of fossil fuels.[47] By 2030 it is possible to expect approximately a 50 percent decline in emissions from coal and a 30 percent decline from oil, assuming aggressive vehicle-fleet turnover with new fuel-economy standards, strict EPA regulations of carbon pollution from coal plants, and increased coal-to-gas switching.[48] Even if natural-gas use stays constant during this interval to 2030, therefore, CO_2 emissions from the combustion of fossil fuels would still be at 3,716.5 mmt, which exceeds the modest 2030 emissions-reduction goal of 3,334.3 mmt of

CO_2.[49] The use of natural gas therefore cannot expand unchecked. Even minor increases in the near term mean that we will need to aggressively drive coal and oil from the U.S. fuel mix.[50]

A report by Deutsche Bank, for example, has investigated the implications for natural-gas use for generating electricity in the context of the Obama administration's targets for emissions reductions.[51] The report finds that the 2020 and 2030 targets are feasible even with a 12 percent increase in the supply of electricity from natural gas by 2030 if there is a 26 percent reduction in the supply of electricity from coal and a 12 percent increase in the supply from solar and wind. In other words, for natural gas to work as a bridge fuel to climate stabilization, a steep reduction in the use of coal energy is required.

There are several reasons to believe that these conclusions about the upper bound of natural-gas use are overly optimistic. The report speculates that after the initial substitution of natural gas for coal through 2030, the 2050 emissions-reduction target is feasible only with a dramatic change such as a "massive increase in renewable energy paired with natural-gas CCS, or a substantial build-up in nuclear energy, or even possibly a geo-engineering or technology breakthrough." To date CCS has not been proven to be cost effective or expandable to a sufficient scale. An additional point of concern is that the report does not account for carbon pollution from total energy use in the United States. It considers only carbon pollution from electricity, but decarbonizing the electricity market is only part of the greater effort needed to meet targets for emissions reductions. This is particularly true given the projected rise of both non-CO_2 greenhouse gases and nonenergy-sector emissions out to 2040. We thus consider 2030 to be an absolute outer limit for peak natural-gas use. It is very possibly not near enough to slow the impacts from climate change.

In addition, a paper by Michael A. Levi of the Council on Foreign Relations investigated the viability of natural gas as a bridge fuel in the context of the 450 ppm target.[52] In his scenario of stabilization at 450 ppm, consumption of natural gas increases from about 20 percent of the global primary energy mix in 2000 to about 40 percent in 2020, almost completely replacing coal. It then declines to about 10 percent by 2050, while zero-carbon energy reaches more than 60 percent.

Given that zero-coal use in 2020 will almost certainly not occur, the amount of natural gas that can be burned without threatening climate safety is likely much lower than the analysis above suggests. Again, an additional point of caution is that the maximum natural-gas use referenced in the paper may be an absolute upper limit because the study does not account for nonenergy-related emissions. The maximum natural gas that can be used, therefore, is likely to be lower than provided in the study.

It is clear that a long-term heavy reliance on natural gas beyond 2030 is incompatible with the emissions reductions necessary to stave off the worst impacts of climate change. To achieve the necessary reductions using natural gas as a bridge fuel, natural gas must quickly displace coal and reach its peak within 7 years to 17 years, before it is quickly displaced by renewable power.[53] To be compatible with a stable climate, therefore, the natural-gas bridge must be extremely short.

This raises important policy questions, as the operational lifespans of new gas-fired power plants contemplated today by utility companies are likely to extend beyond the peak period of when fossil-fuel combustion for electricity must decline. A short natural-gas bridge would therefore involve greater use of the fuel in the near term, but must stop short of initiating a major new wave of investments in natural-gas turbines, which would be expensive and politically painful to power down later.[54]

Creating a prompt shift to zero-carbon electricity

The natural-gas boom is a reality: The United States produced 22,901,879 million cubic feet, or MMcf, of dry natural gas in 2011 and 24,041,904 MMcf in 2012—a 5 percent increase in a single year.[55] For a limited time, natural gas can serve as a transition fuel, displacing coal use and providing reductions in carbon pollution. Long-term expansion of natural gas, however, would severely challenge meeting climate-stabilization targets, even with substantial reductions of coal and oil use over the next 20 years. We therefore propose that the federal government develop energy policies consistent with the following four principles.

1. Manage the natural-gas expansion to protect public health and the environment.

2. Create a swift transition from coal-fired electricity to zero-carbon renewable and efficient energy.

3. Generate revenue from the expansion of natural gas during its boom to fund investments in a clean energy economy.

4. Adopt measures to protect middle-class families and manufacturing companies from any significant energy price hikes that may occur due to LNG exports.

We address these principles below. Increasing the use of natural gas in domestic electricity production as a bridge to meet our short-term 2020 climate goals, for example, must be contingent upon codifying a so-called off-ramp such as a clean energy standard to ensure that 2030 climate targets are met. Otherwise, utilities will naturally gravitate to employ the cheapest fuel without regard to its external costs, including contributions to climate change, and there could be a major wave of investment in natural-gas electricity-generation capacity beyond what is needed for near-term peak supply, which would be politically and economically difficult to write off. The lack of an off-ramp thus would create strong headwinds to transitioning to a clean energy future after 2020. Policies therefore must be enacted to ensure that the use of natural gas has a near peak followed by a dramatic decline.

Manage the natural-gas expansion to protect public health and the environment

- **Enact and enforce strict federal limits on pollution from shale-gas production.** These limits should include national environmental- and health-protection standards for fugitive methane emissions, wastewater disposal, well integrity, water quality and water use, and drinking water. This would include elimination of the "Halliburton Loophole" in the Energy Policy Act of 2005, which prohibited EPA from protecting groundwater from hydraulic-fracturing contamination under the Safe Drinking Water Act.[56] EPA could set minimum national standards to provide a basic level of protection, and states could strengthen the standards depending on local differences. The states would implement the federal standards through permits, as is currently the process. The standards should require full public disclosure of the toxic chemicals and their amounts used in the drilling and extraction/fracking operations, such as the rules currently being considered in California and Alaska.[57] In addition, there should be strict enforcement of EPA's 2012 rules required by the Clean Air Act to reduce air pollution from hydraulically fractured natural-gas wells, which are aimed at reductions of volatile organic compounds—often smog components—and toxics, but also facilitate some methane capture.[58]

- **Strengthen fracking rules on federal lands.** The Bureau of Land Management proposed new rules in 2012 for drilling on public lands that included requirements for chemical disclosures, well-integrity testing, and monitoring of flowback wastewater. CAP reported on the gaps in the proposed rules that needed to be closed.[59] An updated draft of the new rules was released in May 2013 but still contains gaps.[60] The proposed rules require chemical disclosures only after the completion of fracturing, when it is too late for adjacent communities to act on this information. In addition, the rules allow natural-gas operators to seek a trade-secret exemption from disclosing components of their fracking fluid. They also allow natural-gas operators to store flowback water in lined, open pits, which can more easily result in spillage and contamination. The new draft is currently in an extended public comment period.[61]

Create a swift transition from coal-fired electricity to zero-carbon renewable and efficient energy

- **Aggressively phase out coal.** Establishing an adequate price on carbon pollution would be the most effective way to speed the displacement of coal-fired electricity. This could be done directly through an emissions tax or an emissions trading scheme. Phasing out coal also could be done indirectly through strict EPA regulations. Regulations to reduce conventional pollutants such as sulfur dioxide, nitrogen oxides, and mercury from fossil-fuel-fired plants could contribute to the retirement of 19 percent to 24 percent of 2011 coal-generating capacity.[62] With the implementation of the EPA regulations announced by President Obama to limit carbon emissions from new and existing coal power plants, a wave of coal-plant retirements likely will result.[63] Other measures for encouraging the displacement of coal include establishing incentives to retire coal-fired power plants and requiring that carbon output be considered when determining the dispatch order for moving electricity onto the grid.[64] This would prioritize natural gas and renewable energy over coal.

- **Adopt a clean energy standard, or CES, that requires utilities to generate 80 percent of their electricity from no- or low-carbon energy sources by 2035, with at least 35 percent coming from renewable energy and efficiency.**[65] This policy would encourage investments in renewable energy and would limit the portion of natural gas in the electricity-generation mix. A CES would speed the transition from natural gas to low-carbon technologies and thus provide an off-ramp from the higher levels of natural-gas generation. As recent and emerging zero-carbon energy technologies become more readily available and affordable, we must ensure that they are not crowded out of the marketplace by older, previously subsidized technologies. Otherwise, we may be trading in one fossil fuel for another—coal for natural gas.

- **Ensure that natural-gas infrastructure and capacity are not overbuilt.** The increased supply of natural gas has lowered gas prices, thereby increasing demand for gas to generate electricity. This should not, however, lead to a significant increase in natural-gas electricity-generation capacity. Modeling of a natural-gas bridge in the context of climate change suggests that natural-gas generation should peak within approximately 40 percent of total energy supply.[66] Any new natural-gas generation capacity in excess of what is needed to meet this 40 percent threshold could lead to new capital investments in natural-gas plants that would have to be retired early once the transition to lower-carbon sources is complete, thereby wasting some of these investments. Writing off these assets would likely translate to a rate hike on consumers, a scenario that would make a transition to zero-carbon fuel sources much more expensive and difficult. A national CES would help prevent overbuilding natural-gas capacity. State-level renewable portfolio standards, or RPS, would help achieve this goal as well. (An important note of caution regarding any decision to increase natural-gas exports is that increased demand is likely to contribute to overbuilt infrastructure, which, as we note, could make the transition to renewable fuels difficult.) Finally, we must ensure that there is adequate electricity infrastructure—transmission and pipelines—so that existing natural-gas plants can be fully utilized.

Generate revenue from the expansion of natural gas during its boom to fund investments in a clean energy economy

- **Increase revenue from resource extraction on public lands and waters.** Natural-gas, oil, and coal extraction on public lands have risen substantially in recent years. Yet energy companies continue to pay below-market rates in royalties and fees to reimburse the American people for the extraction and sale of these resources from public lands. Increasing royalties from these fossil fuels extracted on public lands is fiscally prudent. Existing law provides the Department of the Interior with the authority to raise royalty rates on public lands without congressional approval.[67] Any increased revenues should be dedicated to investments in efficiency, clean energy, and/or climate resilience. They could also be used to assist workers and communities that are harmed by the transition away from coal.

- **Generate revenue from the broader natural-gas market.** Fees should be generated from natural gas during this boom time. There are many appropriate points during its production and consumption cycle, from levying a price on natural gas extracted at the wellhead all the way through to the point of sale to end users. A wellhead tax would primarily burden producers, but obviously, most of the costs would be passed through to consumers. This would raise overall gas prices, which may discourage fuel-switching to natural gas in the short term, so we must have measures to phase out coal. The revenues from such taxes, as well as a possible export or LNG terminal fee, could fund the priorities listed above. These will benefit middle- and lower-income Americans over the long term by bringing down the cost of renewables and providing protection from severe weather events.

- **Develop a domestic carbon price.** CAP has advocated several policies for pricing carbon, both directly through a carbon tax and market-based mechanisms such as cap and trade and indirectly through measures such as EPA regulation.[68] A carbon tax would raise revenue, stimulate investment in clean energy technologies, and create jobs while reducing carbon pollution. It is a win-win measure that could untangle the ongoing federal budget debate.[69]

Adopt measures to protect middle-class families and manufacturing companies from any significant energy price hikes that may occur due to LNG exports

CAP recognizes that high volumes of LNG exports would put upward pressure on domestic natural-gas prices.[70] The impact of these higher prices on consumers is acknowledged, to varying degrees, in both the NERA Economic Consulting report and the Charles River Associates report on this topic.[71] While the NERA report finds that increased exports would result in a small positive net benefit to the U.S. economy overall, there are worrisome distribution issues. Owners of natural-gas resources would benefit, whereas labor and capital in energy-intensive industries would be harmed.[72] Since the Department of Energy is tasked with determining if export licenses are in the national interest, a mechanism for compensating the impact that price increases would have on the middle class and revitalized domestic manufacturing should be developed if export volumes are in the medium range to high range of projections. One such mechanism could be a fee on liquefaction at export terminals. (During the export process, natural gas must be liquefied, transported, and then re-gasified for use; it is important to note when considering increasing exports that each stage carries capital, energy, and emissions costs.[73]) Due to a number of factors that create uncertainty around the volume of actual exports, however—including the complexities of international demand, domestic price volatility, and the trade issues invoked by nontariff barriers—creating a compensation mechanism should be approached very carefully. The Department of Energy should commission a report through the National Academy of Sciences that assesses the price increases from varying volumes of exports and thoroughly addresses the above issues by levying a fee.

Conclusion

Natural gas has an important role to play in achieving the emissions reductions that are necessary for climate stabilization. In the near term, we should use the expansion in natural gas to aggressively drive coal from the market, given that natural gas burns more cleanly than other fossil fuels and is currently available and affordable. The natural-gas expansion, however, needs to be managed safely and sustainably and without overbuilding long-term electricity-generation capacity that would then need to be retired.

In addition, because the combustion of natural gas produces significant carbon pollution, the consumption of natural gas should peak no later than 17 years from now. Otherwise, the United States will fail to meet its longer-term climate goals.

During the near-term natural-gas expansion, natural gas should be used to aggressively finance investments in climate resilience, energy efficiency, and the development and deployment of clean energy technologies to create a path to a clean energy economy and climate stabilization. We urge Congress and the Obama administration to adopt policies that support the principles in this report.

About the authors

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