CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

THE POLITICS OF PLENTY

Balancing Climate and Energy Security

David Burwell

NOVEMBER 2013

CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

THE POLITICS OF PLENTY

Balancing Climate and Energy Security

David Burwell

Carnegie Endowment for International Peace
Publications Department
1779 Massachusetts Avenue, NW
Washington, DC 20036
P: +1 202 483 7600
F: +1 202 483 1840
CarnegieEndowment.org

This publication can be downloaded at no cost
at CarnegieEndowment.org/pubs.

CP 184

Contents

About the Author

David Burwell is director of the Energy and Climate Program at the Carnegie Endowment. His work at Carnegie focuses on the intersection between energy, transportation, and climate issues, as well as policies and practice reforms to reduce global dependence on fossil fuels.

Before joining Carnegie, he was a principal in the BBG Group, a transportation consulting firm that addresses climate, energy, and sustainable transportation policy with a particular focus on how climate and transportation policies can be better coordinated to promote sustainable development and successful communities. During his career, he served as co-founder and CEO of the Rails-to-Trails Conservancy and as founding co-chair and president of the Surface Transportation Policy Project, a national coalition for reforming transportation policy. A lawyer by training, he also worked for the National Wildlife Federation as director of its Transportation and Infrastructure Program.

He has served on the executive committee of the National Research Council's Transportation Research Board (1992–1998) and is presently on the Board of Advisers of the Institute for Transportation Studies at the University of California, Davis. He served in the Peace Corps in Senegal, West Africa.

Summary

The United States is entering an era of oil and gas abundance. Its new resources will increase U.S. energy security, but they may also undermine climate security—as fossil fuel combustion increases, so too does global warming. Unless Washington enacts a plan to simultaneously advance its competing energy and climate security objectives, it risks squandering the benefits of its new resources and suffering the disastrous effects of climate change.

Key Themes

- New technologies have unlocked vast reserves of fossil fuels in the United States.
- This abundance will improve U.S. energy security by providing the country with reliable, affordable access to the resources required to meet its development needs.
- Fossil fuels like those now accessible in the United States account for a significant portion of greenhouse gas emissions. These emissions are already at alarming levels and will rise further if Washington develops its new resources without reference to their consequences for climate security.
- The United States must substantially reduce its fossil fuel consumption to keep carbon emissions within established global carbon budgets. Exceeding these limits will cause sea-level rise, coastal flooding, infrastructure destruction, and other climate change impacts.
- Present U.S. energy policy promotes the development of all fossil fuels instead of encouraging hard choices about which resources to develop and how best to regulate them to promote carbon efficiency.

Recommendations for U.S. Policymakers

Price carbon. Enacting a tax based on the costs that carbon pollution is predicted to impose on future generations as well as the plausible costs of catastrophic climate change will discourage the use of fossil fuels.

Improve transportation system efficiency. Transportation represents 70 percent of U.S. oil consumption. Alongside vehicle and fuel efficiency improvements, policies that link transportation to land use, such as those that promote mixed-use and transit-oriented development, deserve priority attention in federal transportation assistance programs.

Regulate the use of new resources. Regulatory measures focused on reducing the life-cycle carbon emissions of fossil fuels, strategic management of public energy resources, and significant increases in royalty rates for private extraction of fossil fuels on public lands will promote efficient use of these resources.

Leverage U.S. energy exports to advance carbon efficiency. Washington should establish a regulatory structure that requires all exported U.S. natural gas to meet a low-carbon emissions standard and privileges exports to countries that will use the gas to replace more carbon-intensive fuels. Until this framework is in place, new export licenses should be suspended.

The Challenge of U.S. Energy Abundance

North America is in the midst of a rapid expansion of its commercially recoverable fossil fuel energy supply. An era of constraint in domestic oil and gas supply is yielding to an age of abundance as new technologies unlock vast inventories of "unconventional" fossil fuels, or fuels that were once unknown or inaccessible. As this fundamental shift from domestic fossil fuel scarcity to fossil fuel abundance takes hold, U.S. power to affect both international energy markets and relations among nations is greatly enhanced. But the increased availability of fossil fuels—the combustion of which creates greenhouse gas emissions that contribute to climate change—also creates significant challenges for U.S. President Barack Obama's countervailing desire to play a leading role in global climate protection. Resolving this conundrum will require making difficult choices about how to manage these new resources in a way that aligns climate security and energy security goals.

This new era of relative U.S. oil and gas independence alters global energy geopolitics in several ways. It increases supply in international oil and gas markets, thus deepening the liquidity and reliability of supply for other importers. It strengthens the position of other oil- and gas-importing nations to seek price concessions or even to challenge the established system of linking gas prices to oil prices, which drives up the cost of comparatively cleaner-burning gas. Finally, it reduces the ability of state-owned oil and gas exporters to demand political concessions from takers of their fuels. In each of these areas, U.S. leverage to advance its foreign policy objectives is increased. The sheer size of its fast-expanding domestic oil and gas reserves allows the United States to link its energy import and export policies to its strategic national interests.

The sheer size of its fast-expanding domestic oil and gas reserves allows the United States to link its energy import and export policies to its strategic national interests.

There are several other characteristics of U.S. energy markets that enhance Washington's ability to project its influence across the globe. Perhaps the most important is that the United States, unlike Russia, Venezuela, Iran, and many other oil and gas producing nations, does not depend on rents from fossil fuel taxes and exports to fund programs that deter domestic unrest. This means that the United States is free to manage its new resources for policy outcomes, such as energy and climate security, not simply for revenue generation.

And while the United States does not own energy companies, it does have the ability to regulate the pace, amount, and destination of oil and gas exports (and, in the case of oil pipelines, imports) through an established national or public interest permit process. This allows U.S. leaders to calibrate the inflow and outflow of these fuels across U.S. borders to advance its foreign policy objectives.

The United States also owns and controls the release of over 720 million barrels of oil in its Strategic Petroleum Reserve. In addition to providing an extra layer of energy security, these reserves help defend U.S. energy markets from price spikes (through strategic release into the domestic energy market) and avoid the need to open up new federal lands for oil and gas development that are best reserved for other public uses.

The new reserves have already helped advance U.S. foreign policy objectives by allowing U.S. leaders to conceive and enforce the present sanctions against the import of Iranian oil. While the United States itself imports no oil from Iran, America's reduced need to compete against it allies for oil in global markets was a key factor in securing agreement from countries that do consume Iranian oil, such as those of the European Union (EU), to participate in the sanctions.[1] Tom Donilon, the former U.S. national security adviser, highlighted the importance of the new U.S. energy resources in achieving this result in a recent speech, saying, "The substantial increase in oil production in the United States and elsewhere meant that international sanctions and U.S. and allied efforts could remove over 1 million barrels per day of Iranian oil while minimizing the burdens on the rest of the world."[2]

On the downside, however, this new U.S. energy abundance competes with ongoing climate protection efforts. The energy sector accounts for about two-thirds of greenhouse gas emissions, and more than 80 percent of those emissions are from fossil fuels. The newfound abundance of these fuels makes it more difficult to keep global warming below the 2-degree Celsius (2°C) increase commonly recognized as the redline crossed only at the risk of unacceptable planetary impacts.[3] If staying below this warming threshold is the accepted definition of global climate security, two benchmarks of energy use must be achieved. First, atmospheric concentrations of carbon dioxide must not exceed 450 parts per million. Second, global greenhouse gas emissions from fossil fuels must fall to 50 to 80 percent below 1990 levels by 2050.

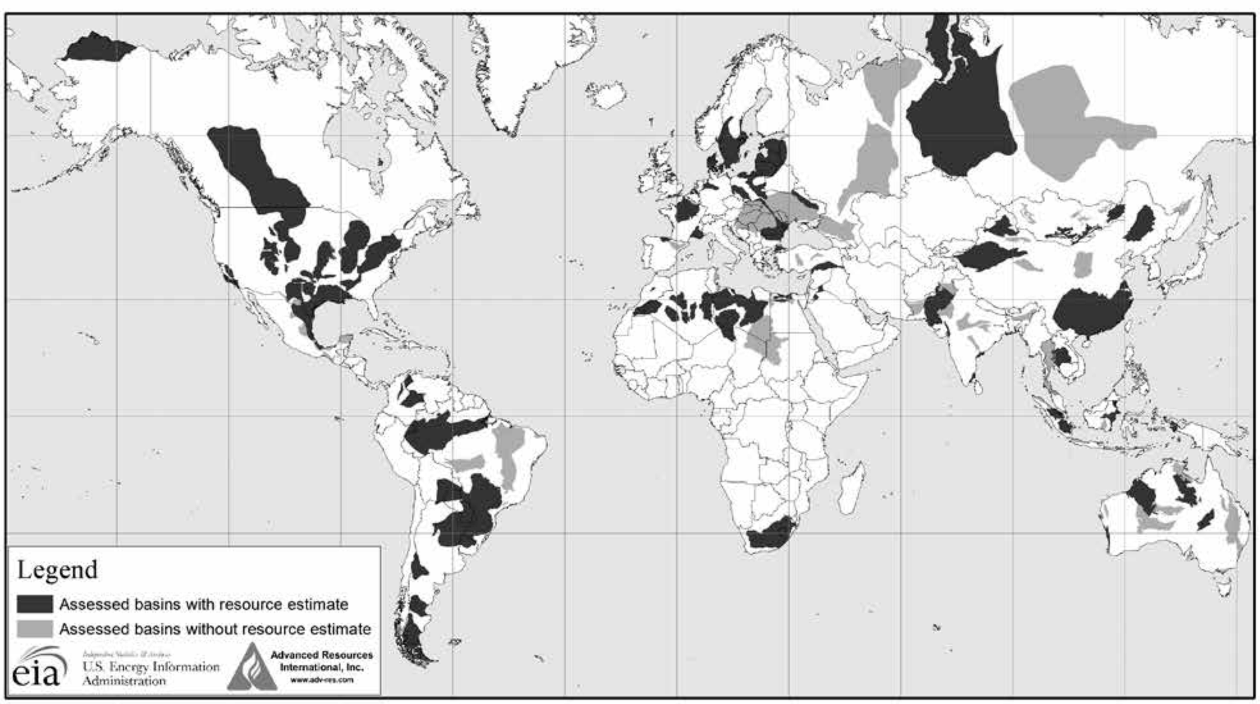
The new oil and gas reserves have made the task of aligning climate and energy security goals even more difficult. The world will continue to discover and develop fossil fuels for the foreseeable future, but the amount of carbon dioxide from energy that can be burned while staying within the 2°C global warming limit is fixed at no more than 1,000 cumulative gigatons. Global carbon emissions had already eaten up half of that budget by 2011, and scientists say that unless emissions are cut rapidly, the remaining budget will be consumed within thirty years—by about 2040.[4] And annual carbon emissions are going up about 2.7 percent per year, not down.[5] All nations would have to collectively cut down on carbon combustion at an ever-increasing rate to reach tolerable levels, but this is not likely to happen.

The policy challenge facing the United States is simple, yet daunting: ensure access to the energy required to meet the country's development objectives while also becoming a leader in global climate protection. To balance these aims, the United States must find a way to develop its new energy resources for domestic and international strategic benefit while simultaneously encouraging all nations to work to keep carbon emissions below the 1,000 cumulative gigaton threshold. This is no small task.

Toward U.S. Energy Security

As more unconventional fuels become available, energy reserves around the world are increasing. According to a new report by the U.S. Energy Information Agency (EIA), total world oil reserves increased 11 percent from 3,012 billion barrels in 2011 to 3,357 billion barrels in 2013, of which 10 percent, or 345 billion barrels, were unconventional oil reserves. The jump in world gas reserves was even more dramatic, increasing 47 percent from 15,583 trillion cubic feet in 2011 to 22,882 trillion cubic feet in 2013, of which 32 percent were unconventional gas reserves.[6] Moreover, this new EIA assessment only covers 41 countries in which geologic data show sufficient near-term promise to make an estimate of their oil and gas resources (see figure 1). The global inventory of conventional and unconventional oil and gas resources will continue to expand in future assessments that include more countries, perhaps dramatically.

Figure 1. **Map of Basins With Assessed Shale Oil and Shale Gas Formations, as of May 2013**

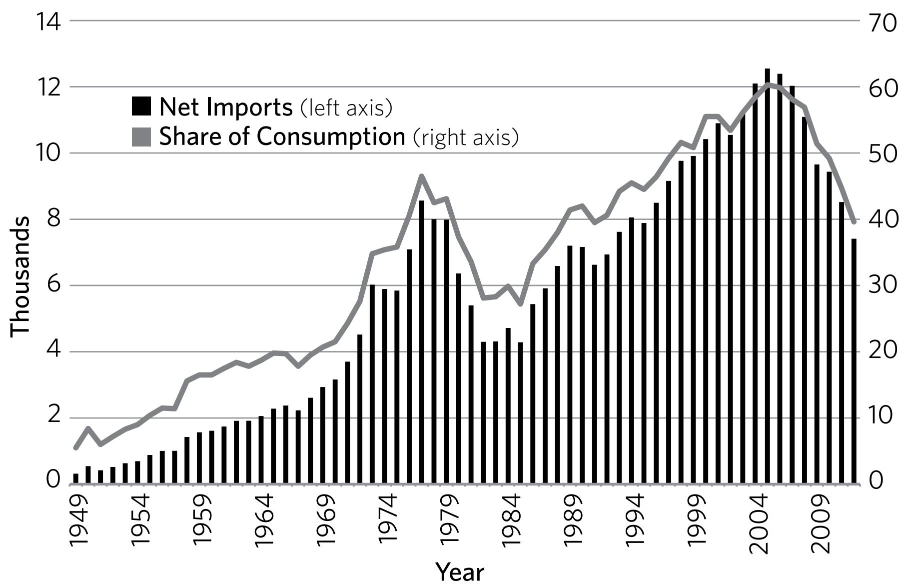


Source: United States basins from U.S. Energy Information Administration and United States Geological Survey; other basins from ARI based on data from various published studies.

Total U.S. conventional and unconventional oil resources are now estimated at 223 billion barrels, and total conventional natural gas reserves are estimated at 2,431 trillion cubic feet. As future fields are discovered, the United States will continue to build its fossil fuel inventory. However, the United States will still own a minority of total global oil reserves (about 6.6 percent) and global natural gas reserves (about 10.6 percent). Moreover, the United States will continue to represent about 18 percent of annual global oil and gas consumption.[7]

Thanks to its new oil and gas abundance, the United States is well on its way to achieving national energy security. The United States is now estimated to become a net natural gas exporter by 2020 and a net oil exporter around 2030.[8] Net oil imports have dropped from more than 60 percent of total U.S. oil consumption in 2005 to less than 40 percent in 2012 (see figure 2).[9]

Figure 2. **Net Oil Imports**
(millions of barrels a day and as share of U.S. consumption)



Source: EIA, "Petroleum & Other Liquid Fuels," February 28, 2012, www.eia.gov/petroleum/data.cfm.

The economic benefits of the United States gaining control over its fossil fuel supply chain through domestic production are, under any analysis, substantial. The reduction in—even possible elimination of—the need to buy fossil fuels on international markets increases domestic wealth, as more dollars stay at home and circulate within the U.S. economy. Unemployment rates in states rich in unconventional oil and gas resources such as Oklahoma, Texas, and North Dakota are lower than 5 percent, compared with a national average rate of 7.3 percent. Secondary impacts from building new energy infrastructure as well as from transporting and refining these new energy sources are estimated to add about 0.5 percent to U.S. gross domestic product (GDP) annually over the next decade.[10] In addition, the low cost of natural gas is causing petrochemical companies that use natural gas in their production processes to relocate to the United States, adding to the country's industrial base.

Toward U.S. Climate Security

With these benefits of relative fossil fuel supply independence for the United States come equally real—and equally severe—threats. The consequences of not meeting the 2°C goal, even with significant investments in both adaptation to and resilience from climate disruptions, will almost certainly overwhelm these economic and energy security benefits.

Settled science—in the form of the more than 850 climate scientists who make up the official Intergovernmental Panel on Climate Change (IPCC) team of global climate experts—warns that a rise of over 2°C will have catastrophic physical, social, and environmental global impacts. Top-line effects include sea-level rise and storm surges inundating major coastal cities; the creation of over 500 million environmental refugees from coastal flooding and the loss of arable land; major infrastructure destruction that will, among other things, cripple air-, water-, and land-based transportation systems; the extinction of between 20 and 30 percent of all existing species; and the migration of invasive species and disease-spreading organisms from tropical to temperate zones, where they will come into contact with populations that have little built-in resistance to the diseases they carry.[11]

These impacts, plus habitat destruction, ocean acidification, and other ecosystem effects with economic consequences, could collectively slow the projected growth rate of global GDP by more than 5 percent.[12] And these figures were calculated in 2007, when glacial melt from the Greenland ice cap was unknown and therefore not counted. Present estimates are that Greenland glacier ice melt alone may add up to 19 inches to common estimates for sea-level rise by 2100. A 2013 IPCC assessment documents additional major threats to transportation infrastructure and logistics, accelerating sea-level rise, the warming of the deep oceans, and increases in storm intensity across all areas of the globe.[13]

While the less developed countries of the world are expected to suffer most from climate disruption, the United States is not immune from these threats. To the contrary, its unique geography tends to put it at a heightened climate risk for two reasons: its lengthy coastlines make the United States especially vulnerable to sea-level rise and storm surges from large storms and hurricanes; and it lacks a southern mountain range to slow down the northward spread of higher temperatures, which will intensify droughts once they reach the American Midwest. The combination of increased coastal storm surges and more acute Midwestern droughts is a one-two punch for which adaptation and resilience planning in the United States will be very difficult, if not futile.

The New Policies Scenario

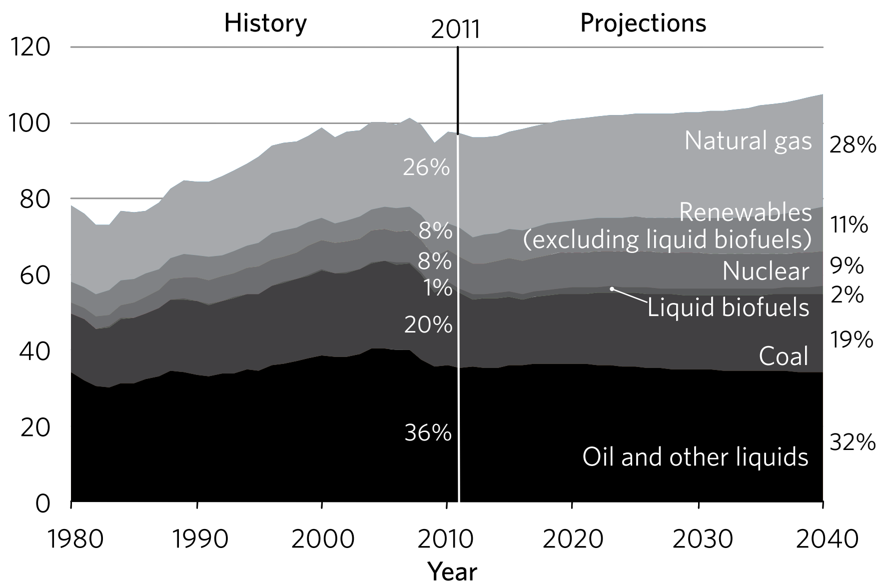
According to the International Energy Agency (IEA), breech of the 2°C threshold is almost certainly locked in already. It warns that present polices to manage fossil fuel supply and demand, even if implemented fully as intended (which is rarely the case), will result in a global temperature rise of between 3.6°C and 5.3°C—with most of the increase occurring in this century.[14] In making this calculation, the IEA assumes that all energy efficiency standards, technological initiatives, renewable fuel standards, and other carbon-reduction policies presently enacted or declared as national energy policy by any nation—including the United States—are fully implemented. This is known as the New Policies Scenario,

Other international institutions are joining the IEA in expressing alarm and taking action. The World Bank, which predicts that breeching the 2°C threshold is a near certainty, has made climate mitigation an institutional priority and will phase out funding of new coal-fired power plants.[15] The International Monetary Fund, which has calculated that global production and consumption subsidies for fossil fuels are over $2.4 trillion annually, or fully 3 percent of global GDP, has said that it will begin to condition financial assistance to client nations on reform of energy subsidy policies.[16]

Because exceeding the 2°C warming threshold appears almost inevitable, the IEA has created a model based on the New Policies Scenario. It determines the levels to which U.S. fossil fuel demand must drop to help keep global warming at or below 3.6°C, or the smallest possible increase under the New Policies Scenario, assuming that global GDP rises at an average annual rate of 3.5 percent through 2035. Under these assumptions, the IEA estimates that total U.S. oil consumption must decline from 6.4 billion barrels per year in 2011 to just 4.6 billion barrels per year by 2035, a compound annual reduction of 1.4 percent a year.[17] Gas is easier; the model calculates that U.S. consumption (not including exports) of natural gas must rise from 604 billion cubic meters in 2010 to 800 billion cubic meters in 2035, a compound average growth rate of 1.1 percent. This will occur largely as a result of lower-carbon natural gas replacing coal for power generation.[18] As a result, coal demand will decline from 718 million tons of carbon equivalent annually to 596 million tons of carbon equivalent over the same time period, a compound average annual decline of 0.7 percent.[19] These benchmarks for U.S. fossil fuel consumption are the best available targets for tracking U.S. performance to meet its proportionate obligation to prevent the planet from exceeding a 3.6°C increase threshold.

The IEA also calculates that by 2035, global fossil fuel combustion must decline from the 81 percent of global primary energy demand it was in 2010 to 75 percent in the New Policies Scenario. In order to keep global warming below 2°C, it would have to decline to 63 percent. On a global scale, renewable fuels (such as wind, solar, bioenergy, and geothermal) must increase from 13 percent of global primary energy demand in 2010 to 27 percent by 2035 in the 2°C scenario, with hydro- and nuclear power representing the total remaining energy demand balance.[20] The challenge facing the United States is slightly larger since fossil fuels represented 82 percent of its primary energy demand in 2011, requiring steeper declines to reach these global targets (see figure 3).

Figure 3. **U.S. Primary Energy Consumption by Fuel, 1980–2040**
(quadrillion Btu per year)



Source: EIA

U.S. Response to Climate Change

Despite its failure to develop a specific plan to meet the IEA targets, the United States has a serious claim to being a new global leader in greenhouse gas reductions. In 2009, at the outset of his administration, Presidnet Obama declared that the United States would reduce its total greenhouse gas emissions by 17 percent below 2005 levels by 2020. Through stimulus-funded investments, administrative actions, and public-private partnerships, such as the commitment of U.S. automobile manufacturers to raise fuel economy standards for new passenger vehicles from 34.5 miles per gallon to 54.5 miles per gallon by 2020, the United States is roughly on track to meet this goal. Present estimates by independent modelers put total U.S. greenhouse gas emissions reductions at between 16 percent and 17 percent below 2005 levels in 2020.[21]

However, there is one significant caveat to this U.S. accomplishment: Washington has moved the goalposts. The selection of 2005 as the base year from which U.S. emissions would be counted was fortuitous in that it represents the all-time high (to date) in annual U.S. greenhouse gas emissions, fully 16 percent above the 1990 U.S. emissions level. Since long-term carbon emission reduction targets of 50–80 percent use 1990 as the base year, even if the United States meets the 17 percent reduction from 2005 levels by 2020, it will still be just 3 percent below 1990 levels. This puts the United States well behind almost all other countries in the Organization for Economic Cooperation and Development in absolute carbon reduction performance based on the 1990 baseline.

The United States must now get back on track toward the 50–80 percent reduction goal, even as it struggles to effectively manage its vast new endowment of commercially recoverable fossil fuels. Until the United States has more specific domestic oil and gas combustion targets consistent with meeting the 2°C scenario, it must at least meet or exceed the reductions in U.S. carbon emissions necessary to claim a leadership role in keeping global warming below 3.6°C by 2035 as modeled by the New Policies Scenario. So far, there is no U.S. plan to meet even this more relaxed target.

Policy Recommendations

If the United States is to claim a leadership role in advancing global climate security, it must develop a specific critical pathway to meeting its greenhouse gas emissions reduction goal. The administration's current "all of the above approach" to energy policy, in which Washington simultaneously pursues more rapid development of U.S. fossil fuels, greater energy efficiency, and technological innovations, is not enough to achieve this objective because it sets no limits on development of the new U.S. fossil fuel resources. Hard choices must be made about how much of the new U.S. energy abundance to develop, how much of it to leave in the ground, and how stringently to regulate both imports and exports of fossil fuels to ensure that the United States is neither importing nor exporting net carbon emissions to or from other nations. There are four policy initiatives that Washington can undertake now that, if combined with existing efforts in improved energy efficiency, regulation of fossil fuels, and new technologies to bring renewable fuels online, can bend the U.S. carbon emissions curve down toward the IEA goals.

Price Carbon Emissions

Economists are almost unanimous in their conclusion that the best way to regulate an activity harmful to society (an externality) is to price it. This is the so-called polluter pays principle as first espoused by Arthur C. Pigou.[22]

However, economists are not as unanimous on how that price is determined, who pays, who receives the revenues (the government or the injured parties), and whether the benefits to the public are worth the transaction costs of establishing such a pricing system in the first place. If transaction costs exceed the benefits, a better solution may be to let the market resolve the problem through private negotiations between the polluter and those harmed by his or her actions.[23]

The basic rationale of carbon pricing is that it "changes the pattern of incentives for future investment, consumption and innovation, directing all three away from harmful activities and toward beneficial ones."[24] Most economists agree that the full cost to society of burning carbon is greater than its private costs (since it produces greenhouse gases that are not priced).[25] But significant disagreement still exists on whether the benefits of explicitly pricing carbon through a tax, as opposed to regulation, exceed the risks.[26] The first major difficulty lies in establishing the correct price point for carbon. The second problem that carbon tax systems face is an ideological presumption that state power to tax anything, especially fossil fuels, inevitably leads to development of a rent-seeking political structure that crowds out both democracy and private enterprise. These challenges have created an almost insurmountable political barrier to federal legislative action on carbon pricing in the United States.

But pricing carbon is not as daunting as it seems. Indeed, the mechanisms for establishing the correct price point are already in place. The U.S. government is required to compute the social cost of a pollutant and conduct a benefit-cost analysis to determine whether the benefit of regulating that pollutant exceeds the cost of doing so. Since carbon emissions are subject to regulation as a pollutant under the Clean Air Act, a computation of the social cost of carbon is conducted and periodically updated. An independent panel that the U.S. Environmental Protection Agency set up to calculate the social cost of carbon, and thus to evaluate the benefits of its regulation under the Clean Air Act, came up with a cost of $38 per ton of carbon dioxide released into the atmosphere based on a 3 percent discount rate over the period 2010–2050.[27]

Some experts have challenged this calculation as arbitrary and "completely made up, with no theoretical of empirical foundation."[28] However, since regulatory actions need only have a rational basis (that is, it cannot be irrational or capricious), disagreement on the appropriate pricing structure is not likely to be a legal barrier to regulating carbon emissions under the Clean Air Act.

There is an equally valid claim that government models underprice the cost of carbon because they "ignore the possibility of a catastrophic climate outcome."[29] This is because the range of catastrophic outcomes is so large that a specific cost cannot be modeled. However, as noted by economist Robert Pindyck, this does not mean a cost cannot be assigned. Pindyck suggests that a carbon price be established based on the plausible cost of future catastrophic climate change.[30] The estimated cost need not be exact, just plausible. The rationale for such action is called the "precautionary principle," which holds that it is wiser to establish the cost of a low-probability, high-impact outcome in the future than to do nothing since the event is so uncertain.[31] If the precautionary principle were adopted, a carbon price could be established to reflect the present, discounted value of mitigating the future cost of catastrophic climate change in much the same way as insurance policies cover the costs of future low-probability, high-cost events.

Calculations of this price would be totally separate from those to determine the social cost of carbon, which focuses primarily on the costs to society of higher temperatures—not catastrophes. A carbon price based on the precautionary principle is assigned as a precautionary hedge for avoiding catastrophic climate change, so it cannot be used to justify replacing a regulatory approach to carbon emissions that does not include catastrophic events in its social cost of carbon index. The two address entirely different events: the present value of avoiding known social costs of higher future temperatures, and the present value of avoiding plausible future catastrophic climate disasters. To continue the insurance analogy, one is health insurance, the other is life insurance.

The threat that a carbon tax will be used to aggregate state power at the expense of democratic principles—"the power to tax is the power to destroy," in the words of former chief justice of the U.S. Supreme Court John Marshall—is easily addressed by rebating all revenues to every valid resident of the United States on an equal basis. This approach affords the state no power to pick winners or losers or to advantage one set of constituencies over another. And an economy-wide carbon tax based on this "price and rebate" system is also progressive, in that the more affluent tend to consume more energy per capita than the less affluent and thus will pay slightly more in carbon taxes, but the rebate will be distributed equally to all legal U.S. residents. In addition, it provides a price signal to conserve since increasing the price of any commodity reduces, at least marginally, demand for it.

Invest in Transportation System Efficiency

Transportation represents more than 70 percent of oil consumption in the United States, and natural gas is beginning to compete with oil as the source of motive power for heavy trucks, transit systems, and, in some instances, even light-duty vehicles. Yet transportation systems, as well as vehicles, are notoriously energy inefficient, even under increasingly stringent fuel economy standards. The IEA estimates that in order to keep below the 2°C threshold the world will have to invest at least $6.3 trillion above present expenditure levels in transportation efficiency—fuels, vehicles, and system efficiency—by 2035.[32]

Significant progress is being made in improving fuel efficiency and vehicle efficiency, especially in vehicles with power trains that run on non-carbon-based fuels. However, improving the overall efficiency of the transportation system itself is much harder. This is because the United States made an "all-in" bet on roads and highways as its primary public transportation infrastructure in enacting the National Interstate and Defense Highway Act of 1956. In addition, more than 30 states still only allow state gas taxes and motor vehicle taxes to be used to build and maintain additional roads and highways, not to fund other transit systems. Most transportation investments are made independent of land development decisions, which means that developers tend to first secure control of cheap land and then seek public funding for road access to that land. The result of this vehicle-focused system is that the number of vehicle miles traveled per year by every man, woman, and child in the United States rose from just under 5,000 miles in 1963 to over 10,100 miles in 2005, then dropped to about 9,500 miles in 2011. Vehicle miles traveled per licensed driver is even higher, at over 14,400 miles in 2007, but it is also beginning to decline.[33]

System efficiency, more than vehicle and fuel efficiency, will be the deciding factor in reducing transportation carbon emissions in the large and small cities of the future.

For the transportation sector to achieve its proportionate share of greenhouse gas reductions, it must radically reform the delivery of transportation services to focus on consumers' needs for access to jobs, services, and opportunities, not on vehicular mobility. This will require fundamental changes in the way cities are planned and built and in how transportation services are delivered. A cultural shift is also necessary—private car ownership must lose its cachet as a ticket to entering the middle class and living the "good life." This is already happening in the United States as many millennials (born in 1980 or later) see car ownership as an expensive and inconvenient transportation option and prefer bike-share and car-share programs as well as real-time access to transit as cheaper, cleaner, and more efficient ways to get around.

Enabling and encouraging these important changes will be a long and difficult endeavor. The policy shift needed to support transportation system efficiency is dramatic and has been largely ignored. The transportation experts who decide how to spend more than $150 billion in U.S. public transportation infrastructure investments each year are largely untrained in providing transportation services not based on the presumption of private car ownership. But the shift is as necessary as it is challenging. System efficiency, more than vehicle and fuel efficiency, will be the deciding factor in reducing transportation carbon emissions in the large and small cities of the future.[34]

Regulate the Use of New Fossil Fuel Resources—Sip, Don't Gulp

The new U.S. energy abundance, if managed through carbon pricing and coupled with an aggressive demand-reduction campaign targeting oil use in the transportation sector, will provide the United States with an increasing amount of discretion on how, where, how fast, and under what conditions it develops its new fossil fuel resources. Smart exercise of this discretion is essential to meeting the IEA targets for oil and gas consumption.

Unfortunately, there are many questions surrounding these new oil and gas reserves—indeed, even on a volumetric basis, experts are just beginning to understand their full size. Other key unknowns include the relative carbon content of these new reserves (both absolutely and by location); how difficult it will be to extract them from the tight oil deposits and shale rock where they are located; the energy consumption, water consumption, land consumption, and air emissions related to their location and development; the infrastructure needed to get them to key markets; how to most efficiently match them to markets; how to manage the potential toxic by-products of their production; and the threat of spills (oil) and fugitive emissions (natural gas) they represent. Only with a more complete understanding of the energy and other natural resource costs required to build and operate this vast new oil and gas infrastructure will it be possible to decide how much of these new resources to extract and from where, what to leave in the ground, and how to fully price the carbon cost of such an enterprise.

For these reasons, much research is required before adopting a "drill, baby, drill" or even an "all of the above" approach to fossil fuel resource extraction. In particular, where these reserves are located on public lands, the Department of the Interior should be cautious in its leasing decisions and aggressive in its oversight functions. The secretary of the interior has the power to set royalty rates and can designate lands suitable for oil and gas development.[35] Creating an index that ranks publicly owned fossil fuels based on their life-cycle carbon emissions—and thus the climate risks they pose—is the first step to making responsible decisions about which fuels to use and how to regulate them.

Once indexed, the Department of Interior has a number of options for regulating the use of these reserves, including leasing oil and gas reserves on federal land with the lowest carbon footprints first; requiring carbon-efficient development practices; assessing royalty rates on extracted fuels based on their life-cycle carbon emissions; and requiring carbon capture and storage of emissions generated on federal land.[36] These frameworks should be coordinated with, not a replacement for, regulatory approaches that encourage the use of the best available control technology for reducing carbon emissions from commercial activities, such as power generation. More research should be done to determine the feasibility of calibrating oil and gas leasing to the carbon intensity of the oil and gas extracted.

Royalty rates have the potential to encourage developers to prioritize carbon efficiency. The Department of Interior and private oil and gas developers are already engaging in debate as to what constitutes a "fair return" in setting royalty rates on public lands, and there is no reason that royalties based on the life-cycle carbon emissions of oil and gas development should not be integrated into this debate. To promote low-carbon development, royalties could be determined on a sliding scale so that carbon-efficient extraction methods and processes would be rewarded through lower royalty rates while carbon-intensive methods and processes would result in higher royalty rates. Such a royalty scheme is particularly worthy of investigation since most carbon-pricing proposals before Congress only attach a carbon fee to the first seller of the fuel—usually the producer selling to the refiner or transmission line owner. Unless carbon pricing is built into the royalty rate, precommercial carbon emissions from production activities would not be priced at all.

The implementation of royalties would not affect the need for a carbon tax. The two are distinct: a carbon tax is a tax on a pollutant that causes societal harm and is priced to offset the cost of such harm, and a royalty is the price paid by the producer for the purchase of a physical asset—publicly owned oil and gas resources. It is not double taxation to sell public oil and gas to a producer through a royalty framework and then tax the producer or consumer who burns that asset and pollutes the environment. Exercising discretion on what public oil and gas the United States puts on the market, regulating the manner in which those assets are extracted, and taxing pollution related to their consumption are all legitimate and separate management decisions over the production and use of publicly owned fossil fuels.

Condition U.S. Energy Exports on Carbon Impacts

The United States should include climate considerations in its energy export decisions. It can do so by establishing a regulatory structure that screens all exports of natural gas for life-cycle carbon impacts in both the United States and the recipient country. This structure should require all exported gas to meet a low carbon emissions standard and prioritize the export of natural gas to countries that will use it to replace more carbon-intensive fossil fuels.

There is no unqualified right to sell fossil fuels produced in the United States to international markets. Under federal law, the U.S. government has wisely reserved the right to determine whether the export of its oil and gas resources is in the public interest.[37] This decision is to be made based on presidential discretion. In the exercise of this right, the president has instructed the U.S. Department of Energy to assess the implications of such exports on both U.S. energy security and U.S. economic security (that is, whether the export of such fuels will result in any net benefit to the U.S. economy).

The impact of oil and natural gas exports on life-cycle net carbon emissions in the United States and the recipient country are not considered in determining whether an export is in the U.S. national interest. This is less of an issue with oil since export of U.S. crude oil has been prohibited since 1975, with the exception of exports to Canada for specific purposes. Natural gas exports, by contrast, depend on this distinction. Gas exports are freely allowed to countries with which the United States has a free trade agreement (FTA), but gas exports to non-FTA countries are subject to the national interest determination.

For example, Japan and South Korea depend on imports for 90 percent or more of their oil and gas demand. In many cases, they can only secure natural gas through long-term contracts that peg the price of natural gas to the world price of oil—or higher. This makes natural gas very expensive and discourages conversion of power generation from coal to gas. But since they do not have FTA agreements with Washington, the United States can only export natural gas to Japan and South Korea if doing so is found to be in the U.S. national interest. If it is, the United States could become a leading supplier of liquefied natural gas to these non-FTA markets.

Executive leadership is needed to establish that carbon efficiency should be a specific factor in the calculation of decisions on whether fossil fuel exports are in the country's national interest. The Department of Energy has been delegated the discretionary power to review all license applications for the export of natural gas to determine "the purpose for export, class of seller or purchaser, country of destination, or any other reasonable classification or basis as the President determines to be appropriate and consistent with the national interest."[38] This discretion is sufficiently broad to apply a climate screen to such exports. This consideration could help determine that all natural gas exported meets a low-carbon performance standard for life-cycle emissions and that the receiving country will use such natural gas to replace a higher-carbon fuel, such as coal. Since the Department of Energy tends to grant export licenses to export facilities that have signed contracts from foreign purchasers, it is not difficult to determine the destination and use of planned exports in the context of the export application.

As of September 2013, the Department of Energy has approved four applications to export domestically produced natural gas to non-FTA countries, amounting to 5.6 billion cubic feet per day of unrestricted natural gas capacity over a period of twenty years.[39] This amounts to about 8 percent of annual U.S. natural gas consumption. None of these export approvals has been screened for life-cycle carbon impacts, either in the United States or in the recipient countries. Since U.S. policy is clear in its goal to reduce U.S. carbon emissions by 17–20 percent by 2020 compared to a 2005 baseline, it would be entirely appropriate to include a life-cycle carbon emissions analysis as part of the national interest determination that guides natural gas exports. Additional export license approvals should be suspended until a protocol for such analysis is developed and applied to these determinations.

Taking on the Challenge

These policy recommendations are not easy to enact or implement. However, tackling tough problems is a hallmark of American resolve and ingenuity and a fundamental reason for present U.S. dominance in global affairs.

In 1962, President John F. Kennedy famously challenged the American people to undertake the task of landing a man on the moon and returning him safely back to earth within the decade. He embarked on this ambitious effort "not because it is easy . . . but because it is hard."[40] Going to the moon was a way to demonstrate America's resolve—and to show U.S. global leadership at a time when the United States was being challenged for such leadership by the Soviet Union.

The new oil and gas abundance within U.S. borders presents the United States with an equally daunting challenge—and opportunity. This is not a chance to show global leadership for its own sake. It is for a more essential and nobler purpose: to lead the world safely into a new, low-carbon energy economy that protects the very planet on which all life depends.

Notes

1 See Erica Downs, "Iran, China and the Nexen Deal," Brookings Institution, 2012, www.brookings.edu/research/articles/2012/10/china-iran-nexen-downs. See also David Gelles, "U.S. Approves $18bn Cnooc Bid for Nexen," *Financial Times*, February 12, 2013, www.ft.com/intl/cms/s/0/2cc88ec2-7529-11e2-8bc7-00144feabdc0.html#axzz2Q5AIAYnV.

2 White House, "Remarks of Tom Donilon, National Security Adviser to the President," April 24, 2013, www.whitehouse.gov/the-press-office/2013/04/24/remarks-tom-donilon-national-security-advisor-president-launch-columbia-.

3 Copenhagen Accord, http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf.

4 Intergovernmental Panel on Climate Change, *Fifth Assessment Report*, forthcoming.

5 Jos G. J. Olivier, Greet Janssens-Maenhout, and Jeroen A. H. W. Peters, *Trends in Global* $C0_2$ *Emissions*, PBL Netherlands Environmental Agency for EU Joint Research Centre, September 2012, 6–7, http://edgar.jrc.ec.europa.eu/CO2REPORT2012.pdf.

6 All figures from U.S. Energy Information Administration, *Technically Recoverable Shale Oil and Shale Gas Reserves: An Assessment of 137 Shale Foundations in 41 Countries Outside the United States,* June 10, 2013, www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf.

7 Energy Information Agency, *Annual Energy Outlook 2013: With Projections to 2040*, DOE/EIA-0383 (2013), April 2013, www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf, 60.

8 International Energy Agency, *World Energy Outlook 2012*, chapter 4; IEA, "Executive Summary," *World Energy Outlook 2012*, www.iea.org/publications/freepublications/publication/English.pdf. The United States is already a net exporter of refined oil product but exports of crude oil are tightly controlled, with exports allowed only to Canada.

9 U.S. Energy Information Agency, "Monthly Energy Review," www.eia.gov/totalenergy/data/monthly/#petroleum.

10 *Changing the Game?: Emissions and Market Implications of New Natural Gas Supplies* (Palo Alto: Stanford University, 2013), vii.

11 R. F. Pachauri and A. Reisinger, eds., *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2007); for the synthesis report see www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. These findings were reiterated in the Fifth Assessment report except that findings for sea-level rise were larger because of improved modeling of land-ice contributions. See *Climate Change 2013: The Physical Science Basis* (Summary for Policymakers), September 27, 2013, www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf.

12 Nicholas Stern, *The Economics of Climate Change: The Stern Report*, January 2007, www.cambridge.org/us/academic/subjects/earth-and-environmental-science/climatology-and-climate-change/economics-climate-change-stern-review.

13 IPCC, *Fifth Assessment Report, Working Group I*, www.ipcc.unibe.ch/AR5.
14 International Energy Agency, *World Energy Outlook* 2012, OECD/IEA, 2012, 23, www.iea.org/publications/freepublications/publication/English.pdf.
15 Jim Yong Kim, "The World Must Do More on Climate Change," *Washington Post*, June 28, 2013, A21, www.washingtonpost.com/opinions/world-bank-president-world-must-do-more-on-climate-change/2013/06/27/e395e758-df5a-11e2-b2d4-ea6d8f477a01_story.html.
16 See International Monetary Fund, "Energy Subsidy Reform: Lessons and Implications," March 27, 2013, www.imf.org/external/np/fad/subsidies/index.htm.
17 This translates into a decline from 17.6 million barrels per day to 12.6 million barrels per day. See IEA, *World Energy Outlook 2012*, 85.
18 Ibid., 138.
19 Ibid., 157.
20 Ibid., 51.
21 Dallas Burtraw and Matt Woerman, "U.S. Status on Climate Change Mitigation," Resources for the Future Discussion Paper, October 2012, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2165472.
22 Arthur Cecil Pigou, *Wealth and Welfare* (London: MacMillan, 1912). See also Pigou, *The Economics of Welfare* (London: MacMillan, 1932).
23 Ronald Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (October 1960).
24 Alex Bowen, *The Case for Carbon Pricing* (London: Grantham Research Institute for Climate Change and the Environment and Centre for Climate Change Economic and Policy, December 2011), 6.
25 At least one group, however, has asserted that carbon dioxide is not imposing any costs on society because "CO_2 is a vital nutrient used by plants in photosynthesis. Increasing $C0_2$ in the atmosphere 'greens' the planet and helps feed the growing human population." See Craig D. Idso et al., *Climate Change Reconsidered II: Physical Science* (Summary for Policymakers), Heartland Institute, 2013, 4.
26 See Robert S. Pindyck, *Climate Change Policy: What Do the Models Tell Us?"* National Bureau of Economic Research, July, 2013.
27 Interagency Working Group on the Social Cost of Carbon, *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866* (May 2013), www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf.
28 Pindyck, *Climate Change Policy*, 13.
29 Ibid., 14.
30 Ibid., 15–16.
31 The precautionary principle is applied in the United States to regulate commercial fisheries on the ground that, since there is no way to accurately calculate the total population of any given ocean commercial fishery, it is legal to take a "precautionary" approach when supplies plummet to allow the fishery to recover even on the basis of incomplete knowledge of whether such action is necessary to save the fishery. See *Sustainable Fisheries Act of 1996*, PL 104-297, 16 U.S.C. sections 1801-1804 (1996).
32 International Energy Agency, *Redrawing the Energy-Climate Map,* World Energy Outlook Special Report, June 2013.
33 See Federal Highway Administration, "August 2013 Traffic Volume Trends," www.fhwa.dot.gov/policyinformation/travel_monitoring/13augtvt/page2.cfm. However, there is a distinct difference based on gender, with licensed males driving an average of 16,550 miles in 2008 while licensed females drove 10,142 miles on average. See Federal Highway Administration, "Average Annual Miles per Driver by Age Group," www.fhwa.dot.gov/ohim/onh00/bar8.htm.
34 The same policy shift is required with respect to freight movement, but is not addressed here.

35 The secretary of the interior must impose a royalty for onshore oil production on federal land of "not less than 12.5 percent in amount or value of the production removed or sold from the lease." 30 USC, Section 225(b)(1)(A). No upper boundary is established. Royalties for oil removed from federal offshore lands are presently set at 18.75 percent of the value of the production but, again, no upper boundary is established.

36 See Irena Agalliu, *Comparative Assessment of the Federal Oil and Gas Fiscal System* (Herndon, Va.: U.S. Department of the Interior, Bureau of Ocean Energy Management, October 2011), www.boem.gov/Oil-and-Gas-Energy-Program/Energy-Economics/Fair-Market-Value/Fair-Return-Report.aspx.

37 For natural gas see 15 USC Section 717(b); for oil see 42 USC Sections 6201, 6212(b)(1).42.

38 These four licenses are DOE/FE Order 2961, August 7, 2012 (Sabine Pass); DOE/FE Order 2913 May 17, 2013 (Freport LNG Expansion); DOE/FE Order 3324, August 7, 2013 (Charles River); DOE/FE Order 3331, September 11, 2013 (Dominion Cove Point).

39 Sabine Pass Liquifaction, LLC, DOE/FE Order No. 2961 (May 20, 2011); Freeport LNG Expansion, L.P., DOE/FE Order No. 3282 (May 17, 2013); Lake Charles Exports LLC, DOE/FE Order No. 3324 (August 7, 2013).

40 John. F. Kennedy, speech at Rice University, September 12, 1962, http://er.jsc.nasa.gov/seh/ricetalk.htm.

Carnegie Endowment for International Peace

The **Carnegie Endowment for International Peace** is a unique global network of policy research centers in Russia, China, Europe, the Middle East, and the United States. Our mission, dating back more than a century, is to advance the cause of peace through analysis and development of fresh policy ideas and direct engagement and collaboration with decisionmakers in government, business, and civil society. Working together, our centers bring the inestimable benefit of multiple national viewpoints to bilateral, regional, and global issues.

The **Carnegie Energy and Climate Program** engages global experts working in energy technology, environmental science, and political economy to develop practical solutions for policymakers around the world. The program aims to provide the leadership and the policy framework necessary for minimizing risks stemming from global climate change and reducing competition for scarce resources.

BEIJING BEIRUT BRUSSELS MOSCOW WASHINGTON

THE GLOBAL THINK TANK

CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

CarnegieEndowment.org