The Economics of America's Clean Energy Future

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The United States is in the midst of an energy revolution. We have led the world in combined oil and natural gas production for three years running, pushing ahead of energy exporters like Russia and Saudi Arabia. Electricity generation from renewables is soaring as well: wind generation has tripled since 2008 and utility-scale generation from solar is up more than tenfold. Meanwhile, U.S. gasoline consumption—which as recently as 2005 was projected to rise steadily into the future—has actually *fallen* 5 percent since that time. This has contributed to cutting our oil imports nearly 40 percent, helping to narrow the U.S. trade deficit to its smallest share of GDP since the 1990s.

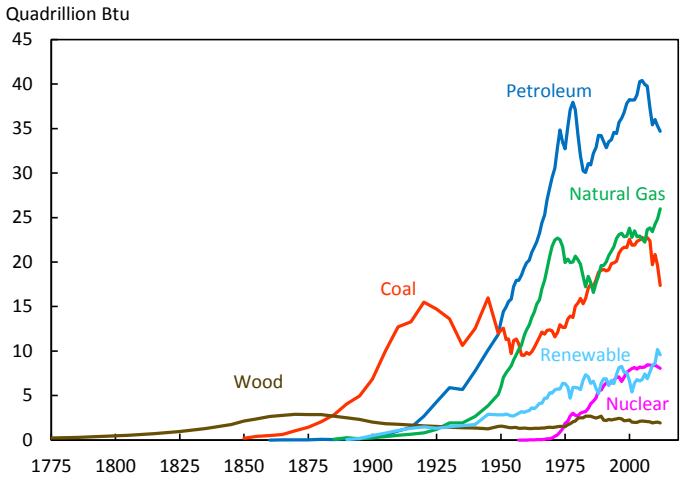
These development are not merely compatible with reduced greenhouse gas emissions, they have been an essential part of how we achieve that goal. At the same time that we have undergone this energy boom, we have also seen a 10 percent reduction in carbon emissions from 2007 to 2013—the largest absolute emissions reductions of any country in the world. While the recession was responsible for about half of these emissions reductions, the other half—which is still a large amount—is the result of the changing ways in which we produce and consume energy.

In my remarks today I will focus on the Climate Action Plan, and particularly on the economics of the recent Clean Power Plan to limit emissions from existing power plans. But first I want to provide some broader context about these steps fit into the Administration's All-of-the-Above energy strategy. This strategy has three prongs: supporting economic growth and job creation; enhancing U.S. energy security, and laying the foundation for a clean energy future.

The Role of Energy in Supporting Economic Growth and Job Creation

We are in the middle of an historic transformation in how we consume and produce energy. Figure 1 provides 250 years of perspective, showing that petroleum and coal use are declining while natural gas and renewables are increasing.

Figure 1: U.S. Energy Consumption by Source, 1775-2012.



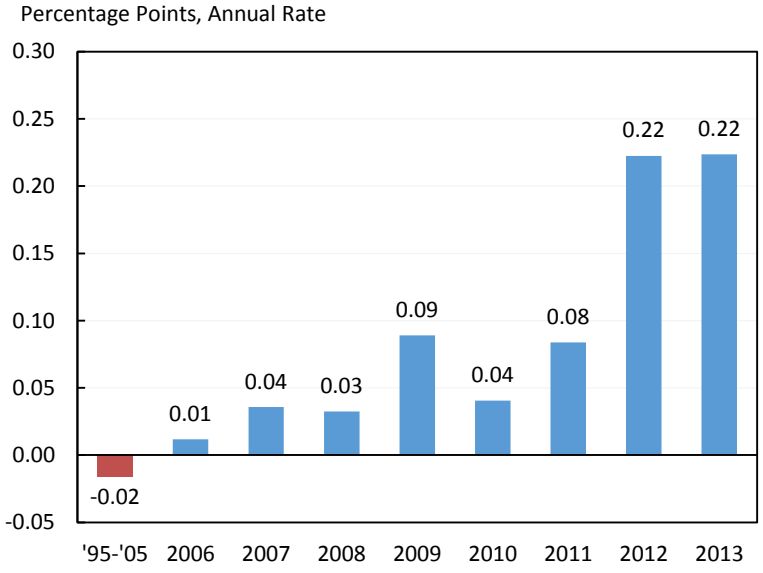
Source: Energy Information Administration

For some fuel sources, like natural gas and renewables, consumption changes are matching shifts in production, as we increase the production of natural gas, especially from nonconventional sources, as well as renewables.

But in the case of petroleum, production has been increasing even as consumption decreases. In 2008 the United States produced 5.0 million barrels of oil per day and production was projected to decline. Today, thanks to nonconventional oil production and advancements in oil-extraction technology, we are producing 8.5 million barrels per day and production is projected to rise. In oil production terms, this is the equivalent of discovering a new Iraq here in the United States.

These developments have contributed to the economic recovery. If you measure just the *direct* contribution of oil and gas production it is adding an increasing amount to growth, as shown in Figure 2. Moreover, these estimates are conservative in that they do not account for spillovers.

Figure 2: Direct Contributions of Oil and Natural Gas Production to GDP growth.

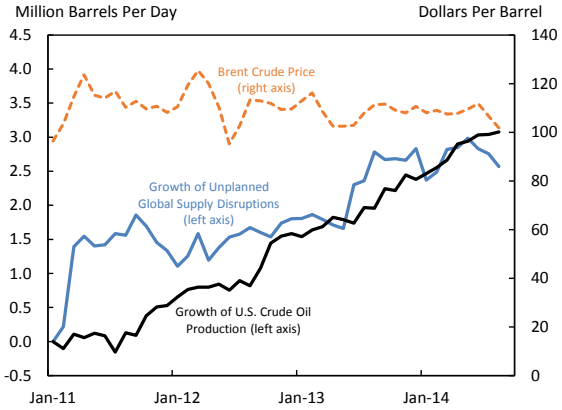


Note: CEA calculations using physical quantity data for oil and natural gas production.
Source: Energy Information Administration; CEA calculations

Enhancing U.S. Energy Security

These developments have enhanced U.S. energy security. One particularly relevant illustration of this is that despite the turmoil in the Middle East, the price of oil has fallen by 15 percent since mid-June and is now below $100 per barrel. Moreover, over the last year oil prices have generally been less volatile than any time in the last decade. This is in part because the increases in U.S. oil production have roughly offset the reductions in supply from the Middle East, as shown in Figure 3.

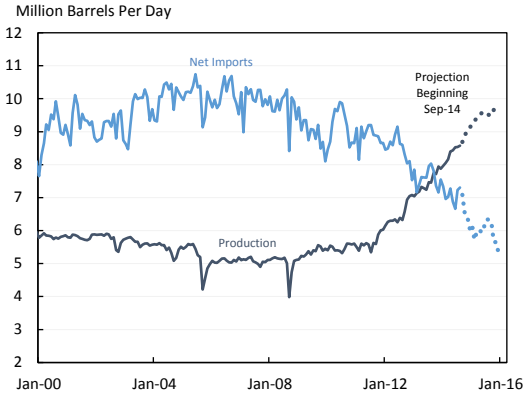
Figure 3: Growth in U.S. Production and Global Supply Disruptions.



Source: Energy Information Administration

Overall the combination of increased oil production and reduced oil consumption means that the United States now produces more oil than it imports, as shown in Figure 4. In June 2005 net imports peaked at 10.7 million barrels per day and were projected to rise still further. Instead they have fallen nearly 40 percent to 6.7 million barrels per day and are projected to continue falling.

Figure 4: U.S. Crude Oil Production and Net Imports.



Note: Projections from the Short-Term Energy Outlook, September 9
Source: Energy Information Administration

The price of oil is still set on world markets. The United States is still vulnerable to events around the world. But increased domestic production means that we are offsetting some of those changes. And reduced imports means that we are less subject to a global terms-of-trade shock; any increases in the world price of oil will not transfer as much resources from the United States to foreign countries. This helps to partially insulate the U.S. macroeconomy from oil supply disruptions, as we demonstrated in a recent Council of Economic Advisers report on the President's All-of-the-Above energy strategy.

Laying the Foundations for a Clean Energy Future

As I said in my introduction, we have made progress on carbon emissions reductions—cutting them by 10 percent from 2007 through 2013. But there is no doubt that we need to make more progress. In 2010 as part of the Cancun agreements, the United States formalized the goal of cutting greenhouse gas emissions in the range of 17 percent below 2005 levels by 2020. This was part of a broader agreement in which more than a hundred other countries, including key emerging economies like China, offered emissions-reduction targets of their own.

Achieving this target will require doing more than just riding the wave of changes that are already underway in the private sector. As we all know, a product's carbon emissions impose greater costs than simply those paid by its producers and consumers. The impact these carbon emissions have on climate change and the economy more broadly are what economists call an externality. As a result, both producers and consumers will not have sufficient incentives to invest in an economically efficient manner both in the way they act today and, perhaps more importantly, in the way they innovate for the future. The result is a classic economic inefficiency where carbon is overproduced, and technologies or practices that would cost effectively reduce carbon emissions are underproduced or underused. And this opens up the possibility of substantial net benefits to steps that internalize this externality.

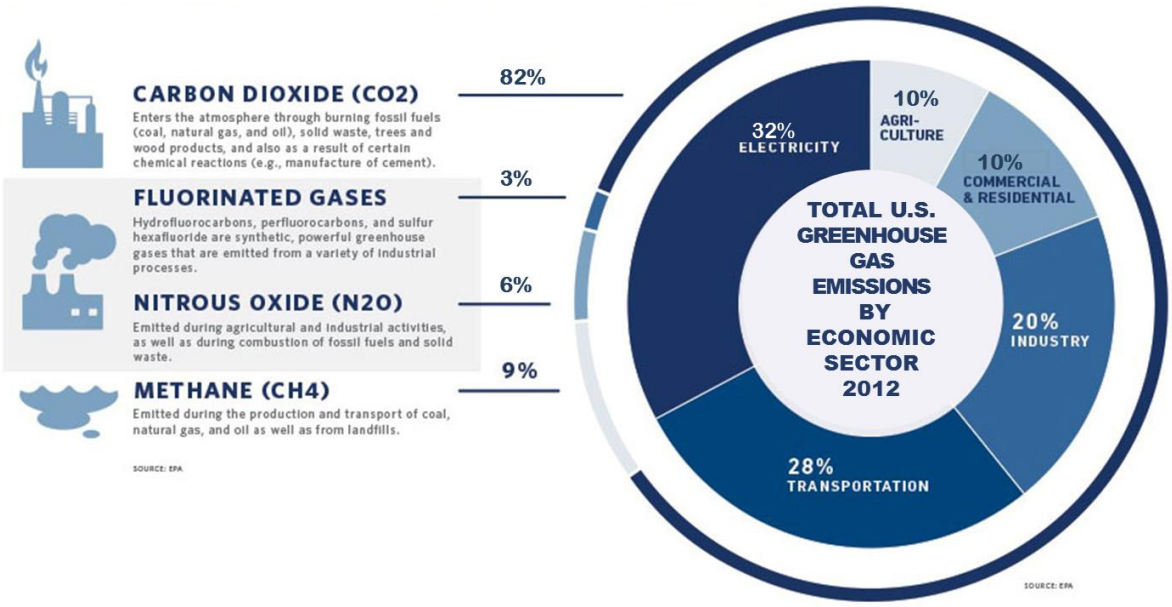
The President has repeatedly asked Congress to take advantage of this opportunity through the legislative process. But in the face of inaction the President put forward a comprehensive Climate Action Plan in June 2013. This plan is designed to cut carbon emissions in the United States, prepare the United States for the impact of whatever climate change does happen, and lead international efforts to address global climate change.

We have already taken some important steps to reduce emissions, including ambitious rules to improve the fuel efficiency of the nation's automotive fleet. And we continue to look for new actions to take, for example just last week we announced commitments from several large U.S. companies to reduce hydrofluorocarbon emissions as well as commitments by States, communities and others to increase the deployment of onsite solar energy.

The next major step in the Climate Action Plan is addressing the 32 percent of U.S. greenhouse gas emissions that come from the power sector, mostly coal-fired power plants, which is the largest source of our overall carbon emissions as shown in Figure 5. In June of this year, the EPA put forward its proposed Clean Power Plan. Under the EPA's proposal, power sector emissions

would be reduced 30 percent from their 2005 levels. Moreover, the Clean Power Plan provides States with the flexibility to use a variety of ways to achieve this goal, including price mechanisms that offer an economically efficient way to ensure that the emissions reductions are being done as inexpensively and efficiently as possible. Because this is so central to hitting our targets for overall emissions reductions, I want to spend most of my time here today discussing the economics of this proposed rule.

Figure 5: The electric power sector accounted for more than 30 percent of U.S. greenhouse gas emissions in 2012.



Source: Environmental Protection Agency

An Overview of the Clean Power Plan

The most important thing to understand about the Clean Power Plan is that it does not directly regulate the behavior of power plants. Rather, it directs *States* to reduce the rate of carbon emissions in their power sector, in terms of tons of carbon emitted per megawatt-hour of power produced or in terms of the total amount of carbon emitted. Let me note that throughout this speech I will be focusing on the EPA's preferred option from the proposed rule, which would reduce emissions 30 percent from 2005 levels by 2030.

Under Section 111(d) of the Clean Air Act, the EPA sets a target for each State by identifying the "best system of emission reductions." This is based on analysis of what leading States and businesses across the country are *already doing* to reduce carbon pollution. In developing the proposed rule so, the EPA looked at measures that are commonly used, technically sound, affordable, and result in significant reductions. States are not being asked to do the impossible, nor rely on technology that does not yet exist. Instead, the EPA projects how much each State could reduce the carbon intensity of its power sector if it caught up to what the most efficient States and plants are already doing today, in 2014. Of course, if the regulation leads to the

development of newer and cheaper ways of reducing emissions than we are undertaking today that would be even better.

More specifically, the EPA's draft standards take account of each State's present energy situation and what potential exists in each State to reduce power sector emissions by applying four approaches:

- improving energy efficiency at existing coal-fired power plants;
- increasing utilization of existing natural gas plants;
- adding new low-emission power sources like wind and nuclear; and
- increased energy efficiency.

These four approaches, or building blocks, form the basis of each State's targets.

Flexibility in the Clean Power Plan

These building blocks, however, do not determine the strategy that States, businesses or consumers must use to reduce their emissions. Instead States have considerable flexibility to develop a strategy that makes sense for their circumstances.

States can choose to work on their own or in coordination with other States to design policies that hit their target, potentially putting more or less emphasis on any particular building block than in the EPA's analysis. For instance, States can push to expand zero-emission energy generation sources like wind, solar, and nuclear, or focus on upgrading existing coal-fired power plants to reduce carbon emissions there. They can choose to assist low-income families in paying the modest increases in electricity prices that may result, or they can aggressively pursue energy efficiency and weatherization programs that reduce demand and lower electricity bills for everyone.

The Plan is not command-and-control regulation. It is not based on the premise that the Federal government knows best. Instead it is in the tradition of recent environmental policies, like the Acid Rain Program and the NOx Budget Trading Program, that have succeeded in cutting pollution while embracing market-based solutions. Indeed, the Clean Power Plan might be the EPA's most flexible initiative ever.

Moreover, States also have considerable flexibility on the timing of these emissions reductions. Specifically, States are also allowed to back-load their emissions reductions during the ten-year implementation window between 2020 and 2030, as long as emissions averages over time stay in an acceptable range. Once the rule is finalized next year, States will have up to three years to formulate their plans and pass appropriate legislation to begin implementing the plan.

While the proposed rules do not mandate a specific approach or set up any kind of federal marketplace, some States may find that the most efficient way to achieve their required reductions is through market-based mechanisms like a cap-and-trade system where statewide carbon emissions are capped and a fixed number of pollution allowances are issued to firms. Such a system ensures that firms face the right incentives to reduce emissions, and simultaneously that emissions reductions find their way to the cheapest place. Under a market-based system like cap-and-trade, a plant whose most efficient way of reducing emissions would involve costly upgrades would have the option to buy permits instead to offset its pollution, while other plants able to sharply curb emissions at modest cost can do so and can get rewarded in the marketplace.

States may also explore other market-based alternatives like a tradable carbon emissions standard or the inclusion of a carbon emissions factor in electricity dispatching decisions, and those options are worthy of further study as well. And of course, States are free to explore any and all options—so if a State finds another solution better suited to its needs, it can pursue that instead.

Benefits of the Clean Power Plan

The estimated benefits of the Clean Power Plan are large. Much of those benefits come in the form of climate damages averted as we sharply decrease the amount of greenhouse gases emitted into the atmosphere. The EPA estimates that climate and weather disasters like storms and droughts cost Americans more than $100 billion in 2012, and these costs are only projected to grow. To cite just one example, a report released by the Risky Business Project notes that between $66 and $106 billion worth of U.S. coastal property may be below sea level by 2050 if we remain on our current greenhouse gas emissions trajectory.

In its Regulatory Impact Analysis for the rule, the EPA estimates that yearly climate and health benefits from the reductions in the Clean Power Plan could range from $55 billion to $93 billion (in 2011 dollars).

The first element of this calculation uses the EPA's value for the social cost of carbon, which is an estimate of the future economic damage—in the form of ruined crops, coastal flooding, disaster relief, extra air conditioning bills, and much more—that can be attributed to each additional ton of carbon gas emitted into the atmosphere. This calculation indicates that we will be sparing ourselves and our descendants billions in climate change-related costs when we meet the emission reduction targets set out in this plan.

In addition to the progress we will make toward reducing greenhouse gas emissions and preventing climate disaster, the second element of the total benefits comes from the reductions in the amount of *other* pollutants being released into our communities. In the course of generating electricity, coal-fired power plants release not only carbon dioxide but also sulfur dioxide, nitrogen dioxide, and particulate matter into the air. All told, the changes induced by the Clean Power Plan will cut these pollutants over 25 percent by 2030. The EPA estimates that this will reduce asthma attacks, heart attacks, hospital admissions, and prevent about 5,000 premature deaths nationwide each year.

Finally, the Clean Power Plan will have benefits lasting far beyond 2030 as it helps the power sector chart a path toward a clean energy future. Firms will have newfound incentive to invest in infrastructure such as high-voltage transmission lines that support new forms of clean power generation like wind and solar. Investments in the power sector are so substantial and so long-lived that decisions made today will affect the course of American power generation for decades to come.

Costs of the Clean Power Plan

While the substantial benefits of the Clean Power Plan are clear, there is no question that we should also take into account any potential costs the plan would have. The flexibility I described is critical to keeping these costs low.

It is important to understand that to the degree there are any compliance costs they will not translate dollar-for-dollar into higher electricity bills for consumers, as energy efficiency programs and technological innovation would lead to reduced electricity demand. The EPA estimates that while there will be a small increase in electricity *prices*, final bills themselves will decline by 8 percent in 2030 as customers reduce their electricity usage and scale up investment in energy-efficiency.

These modest price effects, which can be offset by improvements in energy efficiency, and the fact that electricity costs account for only about 1 to 3 percent of total production costs in most manufacturing industries, should alleviate any concerns that the Clean Power Plan will reduce the competitiveness of the industrial sector.

Overall, the annual costs of this transition are estimated to range from $7 to $9 billion in today's dollars once the plan is fully implemented in 2030, or less than $30 per person per year. These costs are small relative to the benefits of the plan—even the most conservative estimates of climate and health benefits—and are a small price to pay for dramatically cleaner air and a slowdown in harmful carbon pollution that has benefits more than six times as large as these costs.

The Urgency of Acting Now

Some have said that we should wait to develop the perfect plan to deal with carbon emissions instead of acting now. But I do not think we should delay in order to let the perfect become the enemy of the very good. The Council of Economic Advisers recently released a report entitled *The Cost of Delaying Action to Stem Climate Change*. We estimated that delaying plans to achieve a given climate change goal by just one decade increases the costs of achieving that same goal by 40 percent. That is because, if we delay action in achieving a fixed set of climate goals, then we have to incur greater upfront costs to make up for the years in which additional carbon pollution was released into the atmosphere. Meanwhile, we will have lost years of

research in effective carbon-reducing technologies, and made bigger investments in older, carbon-intensive technologies.

Additionally, delay could result in a larger increase in global average surface temperatures—which itself would be costly. Our report notes that if delay led to stabilizing global temperatures at 3° Celsius above pre-industrial levels instead of 2° Celsius, global output would decline by nearly 1 percent. This is analogous to the United States losing approximately $150 billion of economic output each year.

Moreover, delaying would not just affect U.S. emissions—it would also substantially reduce our leverage in the global arena, undermining our ability to secure emissions reductions from other countries that would benefit the United States and the world.

Some say that we should wait until we are sure that climate change is happening and have determined how costly it will be. First of all the basic premise of this argument is wrong—we know climate change is already happening and already imposing costs on communities across the United States. And while it is true that we are uncertain about the exact magnitude of the changes and the costs, this uncertainty is actually an argument for doing more and sooner as a form of insurance, not for doing less and later.

This is because carbon emissions and subsequent higher temperatures also increase our risk of hitting climatological "tipping points," like the potential thawing of Arctic permafrost and the subsequent release of huge amounts of methane—a particularly potent greenhouse gas—which would accelerate global warming. The very worst climatological consequences include the possible melting of the Western Antarctic and Greenland ice sheets, large rises in sea levels, extinction events, and widespread disruption of food and water supplies that could spur a global refugee crisis.

Since the exact temperatures associated with this tipping points are unknown, continuing to emit greenhouse gases and drive up temperatures is an exceedingly risky proposition. The more we can do to reduce emissions now, the less likely we are to trigger irreversible climatic disasters. And because conventional models of the cost of carbon have difficulty incorporating all of these contingencies, the climate benefits of the Clean Power Plan may be substantially higher than even the EPA's estimates suggest.

The ideal approach to climate change would be a market-based program that addresses greenhouse gas emissions from *all* sectors, including transportation, manufacturing, and agriculture. By spreading emissions reductions across sectors, we could take advantage of the lowest-hanging fruit—and ensure that we are not making relatively costly reductions in one sector when cheap reductions are available in another. In fact, the President has repeatedly asked Congress to create pass such a law, but so far Congress has not delivered. Given the imperative to act *now* to confront this problem, the Clean Power Plan is the best way forward.

If we fail, we will face an increasingly dire climate outlook and increased urgency to do something, anything, to fix the problem. But if we succeed, the Clean Power Plan will be

remembered as a significant stepping stone on the path to a healthier climate and a twenty-first-century power sector.

Conclusion

Climate change is often thought of as a scientific problem. I hope I have convinced you that climate considerations are a part of our broader energy strategy, that this energy strategy can make a meaningful difference for our economy, and that it is fully compatible with reduced carbon emissions. We look forward to advancing simultaneously on all of these goals. Thank you for your interest in these issues and I look forward to taking any questions you have.