

“We’ll also keep doing what we can to prevent the worst effects of climate change before it’s too late. Over the past six years, we’ve led by example, generating more clean energy and lowering our carbon emissions.”<sup>1</sup>

**BARACK OBAMA**

“I’m very proud that the state of Vermont banned fracking. I hope communities all over California, all over America, do the same.”<sup>2</sup>

**BERNIE SANDERS**

## On the Record

“Solar power is responsible for only one percent of the progress we have made reducing our carbon dioxide emissions.”

**Oren Cass**, Senior Fellow,  
Manhattan Institute



# Fracking, Not Solar Power, Is Reducing U.S. Carbon-Dioxide Emissions

Oren Cass

## In Reality

For all of the attention and federal funds given to renewable energy, it remains a blip on America’s energy radar: solar power represents *less* than 1 percent of U.S. electricity generation. Wind and solar power together generated less electricity in the first half of 2015 than in the first half of 2014, and investment in the industry has been flat for almost five years, domestically and globally.

U.S. greenhouse gas emissions have fallen significantly since their peak in 2007—more than in any other country. The biggest cause is America’s fracking-led natural gas boom: solar power is responsible for 1 percent of the decline in U.S. carbon-dioxide emissions; natural gas is responsible for nearly 20 percent.

## Key Findings

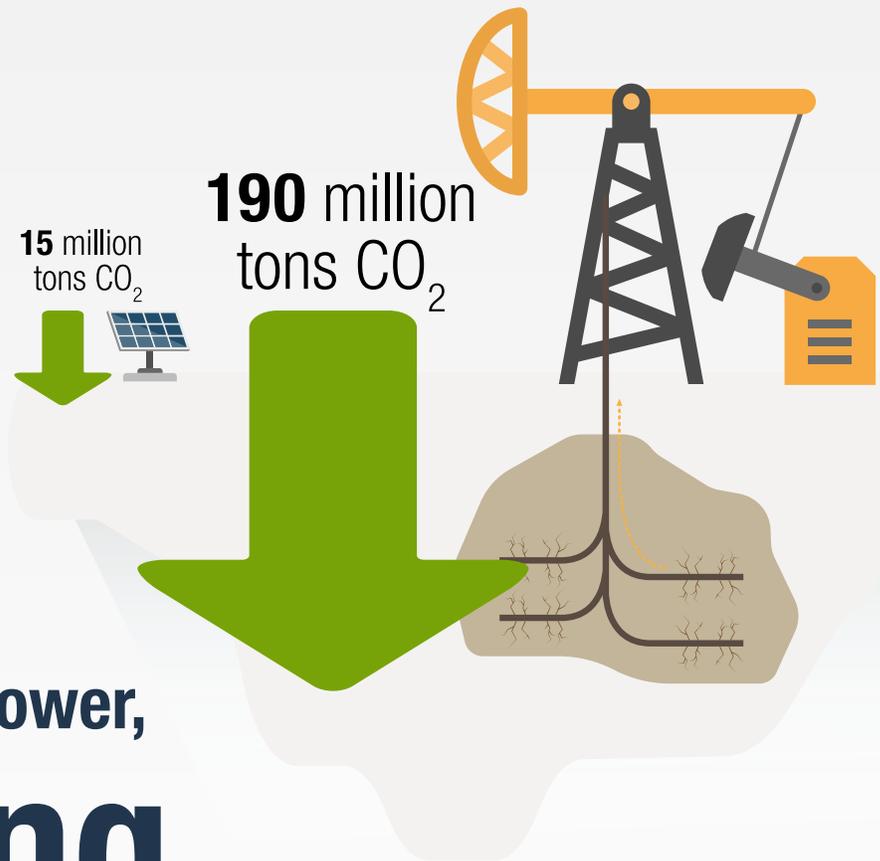
- After peaking in 2007, U.S. carbon-dioxide emissions were 1,022 million tons (Mt) lower in 2014 than had they grown, since 2007, at the same rate as the U.S. economy.
  - ◆ Of that reduction, 19 percent came from a fuel shift toward natural gas for electricity generation.
  - ◆ Only 1 percent came from the increased use of solar power.
- Neither renewable-energy generation nor investment is growing rapidly—or at all.
  - ◆ Year-over-year growth in the generation of wind and solar power has consistently fallen since 2008. Generation in the first half of 2015 was lower than in the first half of 2014.
  - ◆ Global investment in both wind and solar declined in 3Q:2015 compared with 3Q:2014; in the U.S., investment grew slightly but remains below the 2011 peak.

## On the Record

The technology that has done most to reduce U.S. greenhouse gas emissions is fracking. In the past seven years, the fracking-led natural gas boom has cut U.S. emissions more than ten times as fast as solar power has. And while renewable technologies are making significant progress, growth in their investment and deployment is slowing dramatically. Anyone serious about reducing carbon-dioxide emissions should be celebrating fracking both in the U.S. and around the world.”

**Oren Cass**, Senior Fellow, Manhattan Institute

# America's best climate policy? **Fracking.**



For every **ton of CO<sub>2</sub>** cut by **solar power,**

# fracking has cut **13 tons.**

Renewable-energy technologies have achieved impressive gains in recent years; in particular, solar-panel costs have fallen dramatically.<sup>3</sup> As a result, both wind and solar power now find a variety of applications where they make economic sense, sometimes even without a generous federal subsidy. They appear poised for continued progress and increasing deployment in years to come.

However, the growth in electricity generation from these sources looks impressive only in percentage terms. Solar power contributed only 18 billion kilowatt-hours (kWh) to the 3,936 billion kWh generated by the U.S. electricity sector last year.<sup>4</sup> As a result, the country's massive investment in the technology has made virtually no dent in total emissions of carbon-dioxide—and will not make a significant dent for the foreseeable future.

Conversely, the extraordinary technological progress that produced America's natural gas boom has sent natural gas prices plummeting and has driven a substantial shift from coal to natural gas as the fuel generating U.S. electricity. Burning natural gas emits only about half as much carbon-dioxide as burning coal (and even smaller fractions of harmful air pollutants), so its increased use at the expense of coal reduces emissions.<sup>5</sup> Fracking, the technique despised by environmentalists for extracting natural gas from shale, is reducing carbon-dioxide emissions much faster than renewable energy can.

## Energy Efficiency and Fracking—Not Wind and Solar—Are Reducing Carbon-Dioxide Emissions

Without changes in the U.S. economy’s composition or technology, energy consumption would rise roughly in line with economic growth; and carbon-dioxide emissions would rise roughly in line with energy consumption. Lower emissions must be the result of either improved energy efficiency (less energy consumption per unit of economic output) or less carbon-intensive energy (less carbon-dioxide per unit of energy consumption).

From 2007 to 2014, U.S. GDP grew by 7.3 percent (constant dollars).<sup>6</sup> U.S. emissions from energy consumption peaked at 6,001 megatons of carbon-dioxide (MtCO<sub>2</sub>) in 2007. Then, instead of growing by 7.3 percent, along with GDP, to 6,440 MtCO<sub>2</sub>, emissions fell by 9.7 percent, to 5,417 MtCO<sub>2</sub>.<sup>7</sup> How to explain this elimination of 1,022 MtCO<sub>2</sub> of emissions?<sup>8</sup>

Of the reduction, 551 Mt (54 percent) came from electricity generation, 205 Mt (20 percent) came from motor-vehicle gasoline, and the remaining 266 Mt (26 percent) came from all other sources, including industrial uses, heating, and aviation. In the case of electricity, emissions fell from 2,425 Mt in 2007 to 2,051 Mt in 2014; had they risen in line with GDP growth, they would have risen to 2,602 Mt. The eliminated 551 Mt of emissions from electricity generation had three causes:

- **Efficiency.** Electricity use, per dollar of GDP, declined by 8.4 percent, from 0.269 kWh/dollar in 2007 to 0.247 in 2014. This alone would have reduced emissions from 2,602 Mt to 2,383 Mt.
- **Renewables.** Zero-carbon electricity generation increased from 27.5 percent in 2007 to 32.3 percent in 2014. This alone would have reduced emissions from 2,602 Mt to 2,431 Mt. Solar power as a share of total electricity generation increased, from 0.02 percent in 2007 to 0.45 percent in 2014. This represented 9.2 percent of the total zero-carbon increase and, thus, 16 Mt of the 171 Mt reduction. The increase in wind power, from 0.9 percent to 4.6 percent, accounted for 135 Mt. The combined increase in hydroelectric, nuclear, and geothermal power would have contributed an additional 20 Mt reduction.
- **Fracking.** Carbon-dioxide emissions per kWh of fossil-fuel-generated electricity declined by 7.9 percent—from 835 tCO<sub>2</sub> per million kWh in 2007 to 769 in 2014—thanks to a ten-point shift in fuel mix, from 28 percent natural gas / 69 percent coal to 39 percent natural gas / 59 percent coal.<sup>9</sup> This shift alone would have reduced emissions from 2,602 Mt to 2,397 Mt.

Thus, credit for the total 1,022 Mt, accounting for covariance,<sup>10</sup> goes to:

Energy efficiency (electricity)	<b>203 Mt (20 percent)</b>
Fracking-driven natural gas increase (electricity)	<b>190 Mt (19 percent)</b>
Wind power (electricity)	<b>125 Mt (12 percent)</b>
Fuel efficiency (gasoline)	<b>114 Mt (11 percent)</b>
Reduced vehicle-miles (gasoline)	<b>91 Mt (9 percent)</b>
Nuclear, hydro, geothermal power (electricity)	<b>19 Mt (2 percent)</b>
Solar power (electricity)	<b>15 Mt (1 percent)</b>
Other (industrial, heating, aviation, etc.)	<b>266 Mt (26 percent)<sup>11</sup></b>

In 2013, global carbon-dioxide emissions from fossil fuels totaled 36,131 Mt (the most recent year for which data are available),<sup>12</sup> so the reduction achieved by U.S. solar power represented 0.04 percent of global emissions—or less than four hours’ worth.

## This Picture Will Not Change Anytime Soon

Notwithstanding frequent reports that renewable-energy production in the U.S. is “rising at an exponential rate,”<sup>13</sup> its growth has stalled. Since achieving a 60 percent year-over-year increase in 2008, growth in total wind and solar generation has been consistently slowing: 33 percent in 2009, 28 percent in 2010, 27 percent in 2011, 19 percent in 2012, 22 percent in 2013, and 13 percent in 2014—the lowest since 2003. Total generation of wind and solar power actually fell in the first half of 2015 compared with the first half of 2014. Solar continued to grow, but the rate of growth fell by more than half, while wind generation fell in absolute terms.<sup>14</sup>

The growth in new renewable-energy investment has ended, too. In each of the first three quarters of 2015, global investment was below the equivalent quarter in 2014 and below the peak achieved in 2011.<sup>15</sup> This slowdown has afflicted both solar and wind: in the third quarter of 2015, wind and solar investments declined from the third quarter of 2014.<sup>16</sup> Production of solar panels leveled off in recent years as well, growing only 4 percent annually during 2011–13.<sup>17</sup> In the U.S., 2015 investment is above the 2014 level but remains well below its 2011 peak.<sup>18</sup>

Headlines may continue to herald each new renewable installation as a paradigm shift. Analyst reports may continue to celebrate new, hypothetically low-cost, technologies. But energy observers who have to put their money where their mouths are will continue to take a much more cautious approach.

## Endnotes

- <sup>1</sup> See <https://www.whitehouse.gov/the-press-office/2015/10/24/weekly-address-protecting-our-planet-future-generations>.
- <sup>2</sup> See <https://www.youtube.com/watch?v=2qYzDbBHZM>.
- <sup>3</sup> See [http://www.eia.gov/forecasts/aeo/electricity\\_generation.cfm](http://www.eia.gov/forecasts/aeo/electricity_generation.cfm).
- <sup>4</sup> See <http://www.eia.gov/totalenergy/data/monthly/index.cfm#electricity> (September 2015, table 7.2b).
- <sup>5</sup> See <http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11>. This analysis does not include emissions generated by fuel sources or generation equipment during extraction and production processes.
- <sup>6</sup> See <http://www.bea.gov/national/index.htm#gdp> (current dollars and “real” GDP).
- <sup>7</sup> See <http://www.eia.gov/totalenergy/data/monthly/index.cfm#environment> (September 2015, table 12.6).
- <sup>8</sup> For data on allocating emissions reductions, see <http://www.eia.gov/totalenergy/data/monthly/index.cfm> (September 2015, tables 7.2b, 12.1, 12.6).
- <sup>9</sup> Improved efficiency of coal plants was not a factor in reducing emissions: carbon-dioxide emissions, per kWh of electricity generated from coal, changed less than 1 percent during 2007–14.
- <sup>10</sup> Because effects are overlapping (e.g., greater efficiency is “worth” less, in terms of emission reductions, when the electricity also comes from less carbon-intensive sources), the sum of individual effects within electricity-related reductions is larger than the 551 Mt total. Final shares of the total are allocated based on their relative sizes in isolation.
- <sup>11</sup> A significant share of this decrease also comes from increased use of natural gas, not counted in the electricity-specific fracking total.
- <sup>12</sup> See <http://cdiac.ornl.gov/GCP/> (2014 Budget v1.1—includes cement production and flaring).
- <sup>13</sup> See <http://www.bloomberg.com/news/articles/2015-10-06/solar-wind-reach-a-big-renewables-turning-point-bnef>.
- <sup>14</sup> See <http://www.eia.gov/totalenergy/data/monthly/index.cfm> (September 2015, table 7.2b).
- <sup>15</sup> See <http://about.bnef.com/content/uploads/sites/4/2015/10/2015-10-08-Clean-Energy-Investment-Q3-2015-factpack.pdf>.
- <sup>16</sup> See <http://www.bloomberg.com/news/articles/2015-10-08/renewables-shrug-off-slumping-oil-as-investment-remains-steady>.
- <sup>17</sup> See <http://www.eia.gov/todayinenergy/detail.cfm?id=22912>.
- <sup>18</sup> See <http://about.bnef.com/content/uploads/sites/4/2015/10/2015-10-08-Clean-Energy-Investment-Q3-2015-factpack.pdf>.