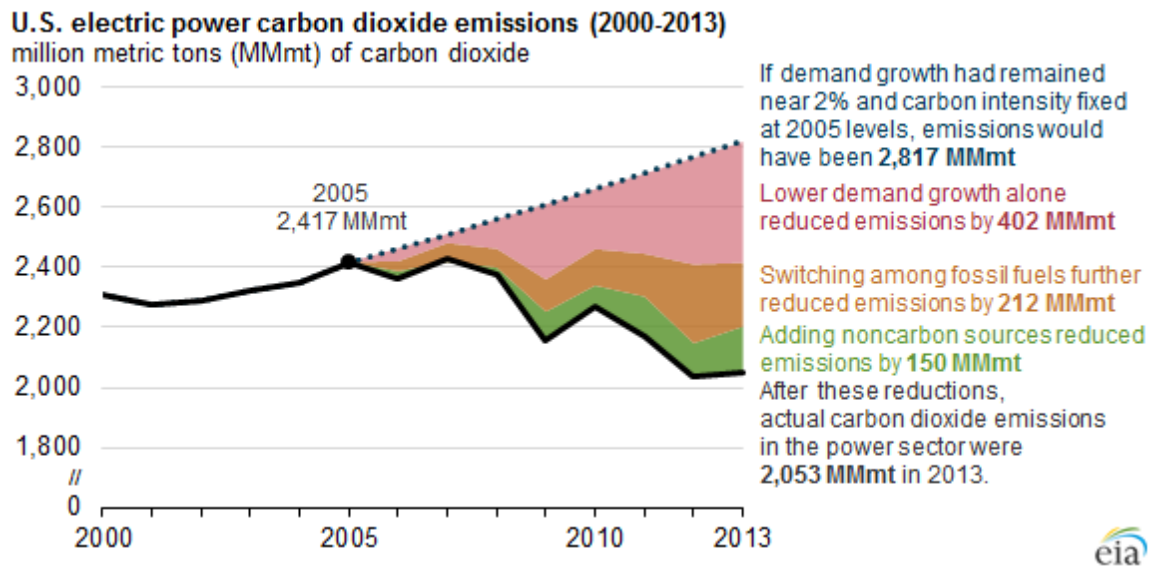


## Impact of Fuel Switching on CO<sub>2</sub> Emissions

You may recall all the hoopla surrounding the reduction in the U.S. CO<sub>2</sub> emissions in 2013, coincident with new-found shale gas resources. We had turned the corner on CO<sub>2</sub> emissions...a true eureka moment!

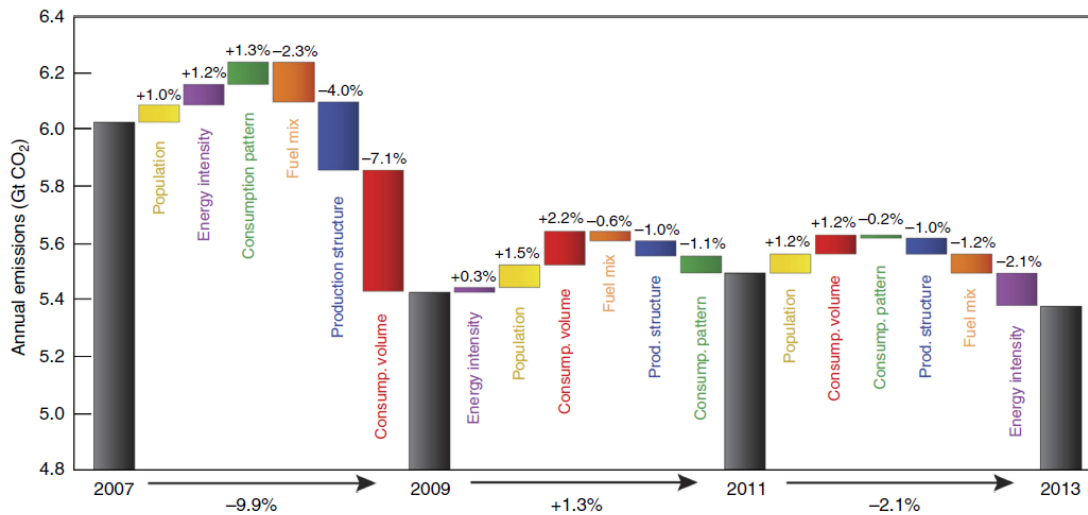
This is what the U.S. Energy Information Agency published at the time. The 2416Mt and the 2053Mt values still exist in EIA's May 2015 Analysis of the Impacts of the Clean Power Plan.



Note: million metric tonnes (Mt) is sometimes abbreviated as MMmt as in the graphic above.

On July 21, 2015, Nature Communications published a fascinating analysis of U.S. CO<sub>2</sub> emissions during same 1997-2013 period. The study was led by University of Maryland's Klaus Hubacek in cooperation with Steven Davis, UC Irvine; Kuishuang Feng and Laixiang Sun.

Here is the graphic that they published, summarizing their findings. Fuel mix is the orange bar:



**Figure 3 | Contributions of different factors to the decline in US CO<sub>2</sub> emissions 2007-2009 and 2009-2011 and 2011-2013.** Between 2007 and 2009, decreases in the volume of goods and services consumed during the economic recession (red) was the primary contributor to the nearly 10% drop in emissions. But between 2009 and 2011, consumption (consump.) volume rebounded, population grew and the energy intensity of output increased, driving up emissions by 1.3% against modest decreases in the carbon intensity of the fuel mix and shifts in production structure and consumption patterns. Between 2011 and 2013, increases in population and consumption volume again pushed emissions upward, but overall emissions decreased by 2.1% due to further changes in production (prod.) structure, consumption patterns, decreasing use of coal and decreases in energy intensity of output. Not shown here, emissions increased by 1.7% between 2012 and 2013, driven primarily by increases in consumption volume.

A few of their conclusions:

*“Commentators in the CO<sub>2</sub> scientific community and media have linked the two trends, celebrating the climate benefits of the gas boom....”*

*Recently, the Third National Climate Assessment of the United States Global Change Research Program also adopted this conclusion, stating that the decrease in US CO<sub>2</sub> emissions was ‘largely due to a shift from coal to less CO<sub>2</sub>-intensive natural gas for electricity production’.*

*Yet, despite potentially significant implications for US climate and energy policy, there has been no quantitative analysis of whether the gas boom and changes in the fuel mix of the power sector are indeed driving the decrease in US CO<sub>2</sub> emissions....”*

***....We conclude that substitution of gas for coal has had a relatively minor role in the emissions reduction of US CO<sub>2</sub> emissions since 2007.***

*.... The large decrease (9.9%) in US CO<sub>2</sub> emissions between 2007 and 2009 was primarily the result of the economic recession...*

*.....the modest effect of changes in the fuel mix of the energy sector on emissions in recent years suggests that further increase in the use of natural gas may be of limited benefit in decreasing emissions. This is because barring technology-specific policies (for example, Renewable Portfolio Standards); recent studies have shown that gas does not substitute for coal only...*

*..... Growth of emission-free technologies such as solar, wind and nuclear energy is also limited while gas is cheap.... In these studies, future increases in natural gas use act to*

*both reduce domestic coal use and slow the growth of renewable energy, resulting in little net change to cumulative CO<sub>2</sub> emissions.*

*.....a growing number of studies also show that increased leakage of methane from new natural gas infrastructure can offset CO<sub>2</sub> reductions relative to coal...*

*.....Decreases in residential gas prices may lead to rebound effects if people spend some of the money they saved heating their home on carbon- and energy-intensive goods....*

*.....And finally, decreased domestic demand for coal has enabled an increase in US coal exports to eager and growing overseas markets.”*

**The new EPA Clean Power Plan is largely built on fuel switching and renewables deployment.**

The article may be found here:

<http://www.nature.com/ncomms/2015/150721/ncomms8714/full/ncomms8714.html>