

# Climate Change, Coal and Kentucky

In this document, you can expect to find:

- Definitions of global warming, the greenhouse effect and climate change and learn why they are detrimental to our health, our ecosystem and our world;
- Levels of greenhouse gas emissions both globally and nationally;
- Coal's contribution to national and global climate change, as well as Kentucky's role in those emissions as a major coal-producing state;
- And, the potential effects of climate change on Kentucky's weather, agricultural patterns, people and ecosystem.

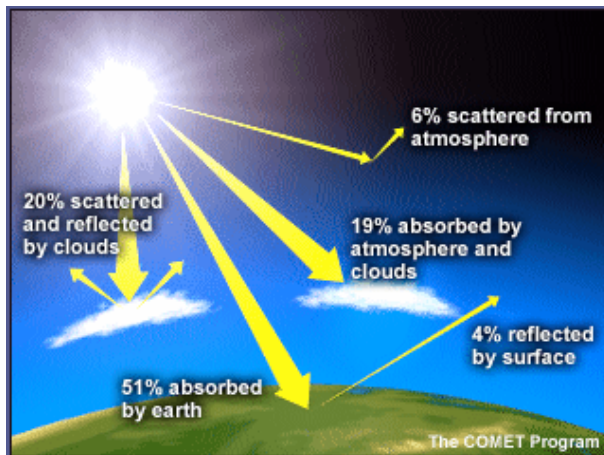
## THE FACTS ABOUT CLIMATE CHANGE<sup>1</sup>

**Climate Change** refers to a host of significant, long-term changes in earth's climate observed over a long period of time, in large part caused by human activity. Climate changes include unusual, erratic weather patterns, changes in earth's water systems, global warming, increasing numbers of rodents and insects that carry diseases and frequency of natural disasters such as storms and droughts.

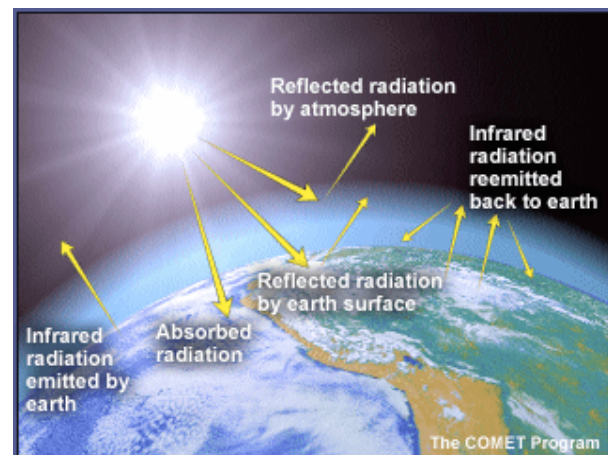
**Global Warming** refers to a modern, unnatural trend of increasing climate, surface and ocean temperatures. The **Greenhouse Effect**, an excess build-up of greenhouse gases (largely those that are emitted during fossil fuel combustion such as carbon dioxide and nitrous oxide) near the earth's surface that absorbs and traps the sun's heat, is the primary cause of global warming.

How does the greenhouse effect work? We need both light and heat from the sun. Infrared radiation, in the form of sunlight, is continually advancing towards earth. A portion of it is reflected by the outermost layer of the atmosphere, some is scattered by clouds and some is absorbed into the earth. The remaining portion is reflected from the earth back out into space. Earth's normal radiation and heat balance between what remains and that which is reflected back to space is disturbed by greenhouse gas emissions. These gases trap heat normally reflected back to space into the lower levels of our atmosphere, thereby causing warming trends in the earth's weather, surface and ocean temperatures.

Normal Sunlight Refraction:



Mechanism of the Greenhouse Effect:



Global warming is magnified by the fact that, as temperatures rise, earth's ice caps and glaciers are melting more and more rapidly. Due to decreased ice, less heat is reflected away from earth by the ice and the problem grows even worse. The United Nations Intergovernmental Panel on Climate Change (IPCC), a major consortium of international scientists and governmental representatives, stated in its 2007 report that they are 90% certain that the recent increase in greenhouse gases within the earth's atmosphere has been caused by human activity.

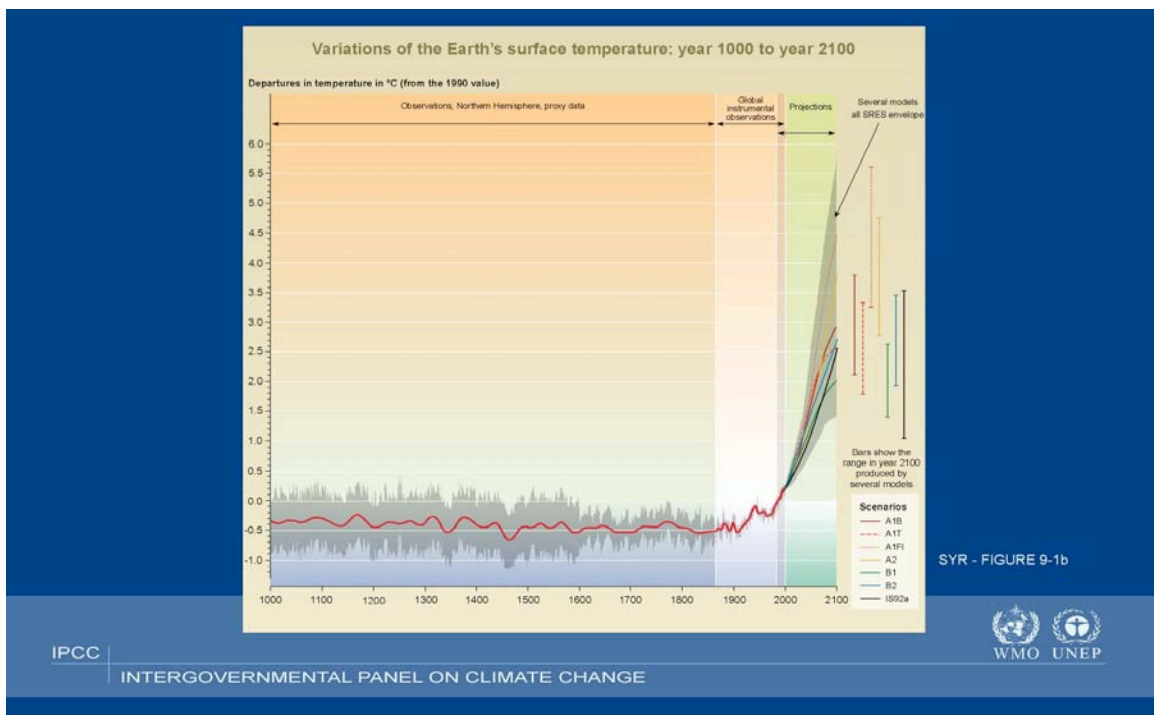
## GLOBAL GREENHOUSE GAS EMISSIONS <sup>2</sup>

Global emissions by gas, all sectors combined:

Carbon Dioxide 77%, Methane 14%, Nitrous Oxide 8%, Other gases 1%

| Gas                               | Pre-Industrial Atmospheric Concentration | Current Atmospheric Concentration | % Increase Since 1750 | Global Warming Potential                    |
|-----------------------------------|--|-----------------------------------|-----------------------|---|
| Carbon Dioxide (CO <sub>2</sub> ) | 270 parts per million                    | 384 parts per million             | 42%                   | Used as a comparison baseline               |
| Methane (CH <sub>4</sub> )        | 700 parts per billion                    | 1,745 parts per billion           | 150%                  | 21 times more damaging than CO <sub>2</sub> |
| Nitrous Oxide (NO <sub>2</sub> )  | 270 parts per billion                    | 314 parts per billion             | 16.3%                 | 298 time more damaging than CO <sub>2</sub> |

Global temperature has risen dramatically in recent years, right alongside the increases in global greenhouse gas emissions. In fact the slopes of carbon dioxide emissions and temperature increases look nearly the same. The graph below shows average earth temperature between 1000 and 2100 A.D. This graphic illustrates the fact that recent temperature increases are well beyond what would be considered normal temperature variations over time by climate scientists.



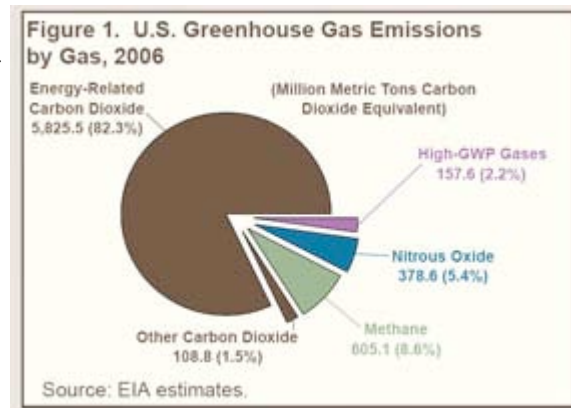
## U.S. GREENHOUSE GAS EMISSIONS

Annual greenhouse gas emissions in 2006 totaled 7,075 million metric tons carbon equivalent (MMTCE). MMTCE is a measure that **builds the emissions from various** greenhouse gases based upon the potential negative impact they have on the environment. For example, the global warming potential for methane over 100 years is 21. This means that emissions of one million metric tons of methane is equivalent to emissions of 21 million metric tons of CO<sub>2</sub>.

Worldwide, carbon dioxide represents 77% of greenhouse gas emission. But in the U.S. this figure rises to 83.8% because of our heavy use of coal and lack of controls on CO<sub>2</sub> emissions.<sup>3</sup>

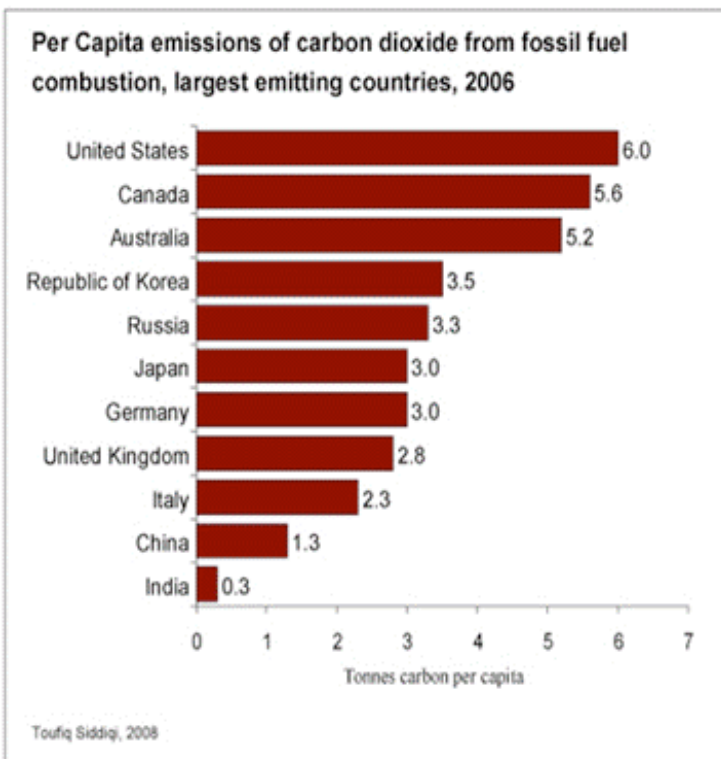
The following gases comprise human-made U.S. greenhouse gas emissions:

- Carbon Dioxide – 83.8%
- Methane – 8.6%
- Nitrous Oxide – 5.4%
- Other Greenhouse Gases – 2.2%



Despite being only 4% of the world's population, the U.S. ranks first in the world in terms of overall greenhouse gas emissions.<sup>4</sup> While emissions from countries bigger in population, such as

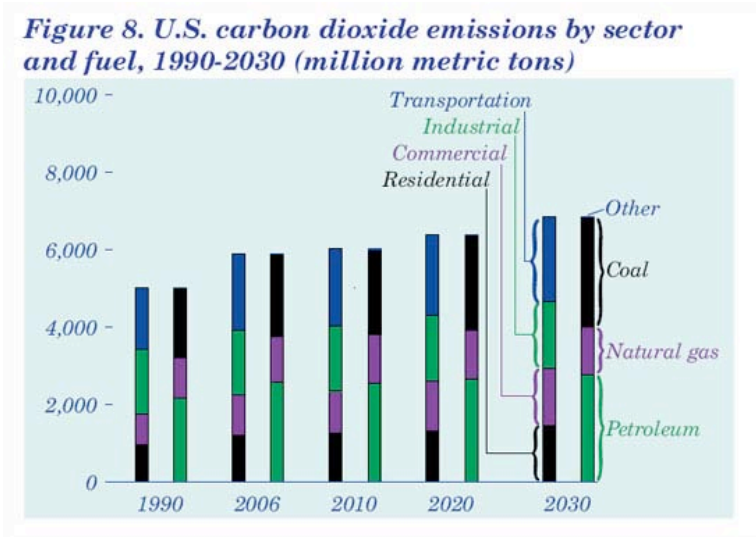
China and India, have grown massively in recent years, the U.S. is still the highest in terms of per capita greenhouse gas emissions. Further, we produce almost a quarter of the entire world's energy-related CO<sub>2</sub> emissions every year.



According to the Energy Information Administration, U.S. emissions dropped by just over 2% in 2006 and this was the first decrease in several years. Yet, projections indicate that this rate of decrease is not adequate to curb our disproportionate impact on global warming in time to avoid negative climate change impacts on our land and people as well as throughout the world.<sup>5</sup>

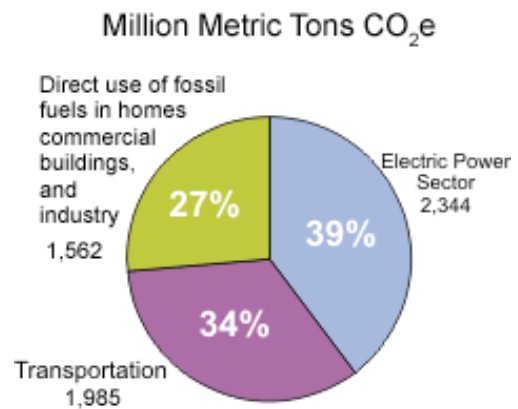
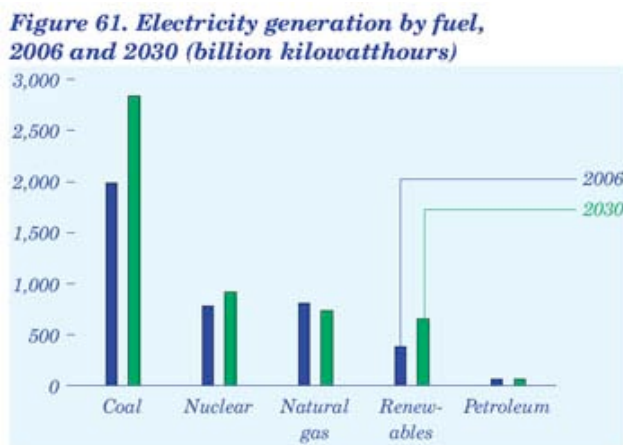
## COAL'S ROLE IN U.S. GREENHOUSE GAS EMISSIONS

Our country relies on coal for half of its electric power needs.<sup>6</sup> U.S. greenhouse gas emissions increased nearly 15% from 1990 to 2006, primarily in CO<sub>2</sub> emissions due to fossil fuel combustion increases.<sup>7</sup>



Emissions from U.S. coal combustion comprise 36% of all CO<sub>2</sub> emissions and nearly 10% of the entire globe's CO<sub>2</sub> emissions. Carbon dioxide emissions from coal are the fastest growing portion of U.S. emissions, having increased 20% since 1990.<sup>8</sup>

Consumer electricity consumption comprises the highest proportion of fossil fuel use. If demand for electricity were reduced, both from residential and industrial customers, greenhouse gas emissions from coal combustion would decrease.



Source: Energy Information Administration

## KENTUCKY COAL'S CONTRIBUTION TO EMISSIONS

Kentucky's coal-fired power plants emitted the following in 2002 (most recent available):<sup>9</sup>

- 198,541 tons of NOx
- 98,037,498 tons of CO2
- 4,412 pounds of mercury (not a greenhouse gas, but a very hazardous pollutant)

Kentucky is 3<sup>rd</sup> in total annual U.S. coal production, accounting for 10% of national production and 25% of production east of the Mississippi River. Nearly one-third of all U.S. coal mines are in Kentucky. 80% of the coal produced here is shipped to 30 U.S. states as well as other countries.<sup>10</sup> While the fuel is shipped out of our state, Kentuckians pay the environmental and health costs of coal mining and coal-fired power production.

Kentucky's coal production and energy plants are technologically outdated using more coal than modern plants to produce power. The plants therefore contribute larger than necessary amounts of greenhouse gas emissions in the process.<sup>11</sup>

Kentucky's industrial sector energy intensity (electricity used per unit of good produced) is **427%** higher than the national average.<sup>12</sup> Energy-intensive industries are attracted to Kentucky because state electric costs for industries are the 5<sup>th</sup> cheapest in the whole U.S., at 4.28 cents per KW hour in 2007. Residential costs, on the other hand, averaged 7.4 cents per KW hour last year — almost double industrial rates.<sup>13</sup>

Kentuckians have one of the largest “carbon footprints” in the United States. Kentuckians emit more carbon dioxide per person than people in all but seven states in the U.S., emitting 35 metric tons per person annually compared to the national average of 20.<sup>14</sup> Of the 100 largest U.S. metropolitan areas, Lexington has the biggest per capita carbon footprint and Louisville has the 5<sup>th</sup> biggest. The study looked at three primary measures in making these estimations — residential vehicle miles traveled per capita, residential electricity used per capita, and carbon footprint of that electricity power source.<sup>15</sup>

### **Kentucky's Dirtiest Power Plants<sup>16</sup>**

*\*Rankings based on review of 378 U.S. power plants emitting 2 million mega-watt hours or more.*

Kentucky has the 4<sup>th</sup> dirtiest power plants in the nation for CO2 emissions per mega-watt hour generated. There are 56 coal-burning units at 22 electric power plants in Kentucky, making us 6<sup>th</sup> in the nation in overall coal-powered energy production.

Nationally, Paradise Fossil Plant run by Tennessee Valley Authority in Muhlenberg County is 24<sup>th</sup> dirtiest and Ghent Power Plant run by Kentucky Utilities, an EON company, in Carroll County is 36<sup>th</sup> dirtiest.

## EXPECTED IMPACTS OF CLIMATE CHANGE ON KENTUCKY

If the coal industry succeeds in misleading our nation into the belief that coal is a “clean source” of energy for the future, coal production will be drastically increased to meet electricity needs. These practices will remove forest cover from Kentucky lands at an even more rapid rate than today, increase greenhouse gas emissions, thereby intensifying climate change in our own state. Since 1980, 1.14 million acres of forest, or about 11% of eastern Kentucky lands, have been already clear-cut due to surface mining practices.<sup>17</sup>

Climate change has greatly impacted Kentucky’s weather over the last century. There has been a statewide trend in decreasing inter-season temperature variability. Summers are as hot as they used to be, but winters are not nearly as cold as they were in the past.

In terms of future temperature changes, projections made by the United Nations IPCC suggest that by 2100, state temperatures could increase by 3°F in all seasons. Precipitation is estimated to increase only slightly in winter (mainly due to decreased ice), by 20% in spring and fall, and by 30% in summer. The frequency of extreme hot days in summer is also expected to increase. The number of rainy days is expected to decrease, but large, intense rains that release high volumes of water, such as thunderstorms, will increase.

Climate change may increase concentrations of already elevated ground-level ozone in Kentucky. Ground-level ozone is formed by an interaction of nitrous oxides (emitted from fossil fuel combustion) and volatile organic compounds (naturally found in air)—it is very harmful to human, animal and environmental health. It can cause or exacerbate respiratory illnesses, cancers and a host of other diseases. A 2°F warming, with no other change in weather or emissions, could increase concentrations of ozone, a major component of smog, by as much as 8%. If a warmed climate causes increased use of air conditioners, air pollutant emissions from power plants also will increase.

Climate change could expand the habitat and infectivity of disease-carrying insects, thus increasing the incidence of Lyme disease and other tick-borne diseases in our state. Predicated warming will adversely affect a number of mammals and reptiles native to our area. For example, Kentucky is famous for its high numbers of bats, mammals which drastically lower the numbers of mosquito and other insects in the area. Bat mortality has already increased and even more are expected to die as a result of these climate pattern changes.

Expected decreases in water flow and higher temperatures could worsen state water quality, already damaged by coal mining operations. Evaporation and decreased soil moisture will necessitate a change in agricultural planting patterns.<sup>18</sup>

## REFERENCES

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- <sup>2</sup> IPCC. Climate Change 2007.
- <sup>3</sup> Energy Information Administration (EIA). 2006 Emissions of Greenhouse Gases Report. Available: <http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html>.
- <sup>4</sup> United Nations Convention on Climate Change. Greenhouse Gas Inventory Data. Available: [http://unfccc.int/ghg\\_data/items/3800.php](http://unfccc.int/ghg_data/items/3800.php).
- <sup>5</sup> Matthews, Damon and Ken Caldeira. "Stabilizing climate requires near-zero emissions." Geophysical Research Letters. 35: 10.1029, February 2008.
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- <sup>9</sup> Clear the Air. "Kentucky's Dirty Power Plants." Available: [www.cleartheair.org](http://www.cleartheair.org).
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- <sup>13</sup> EIA.
- <sup>14</sup> U.S. Department of Energy State-by-State carbon dioxide emission rankings, 2003. Published 2007.
- <sup>15</sup> Brown, Marilyn, et al. Shrinking the Carbon Footprint of Metropolitan America. Brookings Institution: May 2008.
- <sup>16</sup> Environmental Integrity Project. Available: [www.environmentalintegrity.org](http://www.environmentalintegrity.org).
- <sup>17</sup> Estimated based on data supplied by the Appalachian Regional Reforestation Initiative and land survey estimates from the Kentucky Geological Survey. Available: <http://arri.osmre.gov/KYResearch.htm>.
- <sup>18</sup> Preceding paragraphs after paragraph 1 on this page taken from EPA brief no. 236-F-98-007j. "Climate Change and Kentucky." Available online: [www.epa.gov](http://www.epa.gov).