SOLAR ENERGY SAVINGS

FOR YOUR HOME

Dear Future Apex Resident:

Welcome to the Town of Apex, the Peak of Good Living!

To establish Apex as a regional leader in renewable energy production, the Mayor and Town Council are removing obstacles to and providing encouragement for solar photovoltaic (PV) systems to be installed throughout the community. To this end, the Apex Town Council has enacted some of the best solar energy policies in the state of North Carolina including electric metering that enables homeowners to benefit from all the energy generated by their solar PV system at their current rate. In other words, the more you generate, the less you buy, and any excess generation is "purchased" from you at the rate you pay us for the power.

Many new homes in the Town of Apex are "solar-ready", meaning that they include electrical conduit connecting the roof to an electrical supply panel which facilitates the installation of solar PV systems. It is worth noting that if a solar PV system is installed on your new home during the construction phase, it can be more easily integrated into the roofing and electrical systems of the home.

You may even be able to finance the cost of the solar PV system within your home mortgage if installed during construction or qualify for a federal tax-credit. The U.S. Department of Energy provides additional details on how to purchase a solar PV system and take full advantage of the federal incentive program at https://www.energy.gov/energysaver/planning-home-solar-electric-system.

The Apex Town Council is also leading the way by funding the installation of solar PV systems on many Town owned buildings. Won't you join us in our effort to make Apex the Peak of *Green* Living?

You can learn more about Apex's solar energy policies at https://www.apexnc.org/1195/Solar-Program.

Respectfully,

Lance Olive, Mayor
Nicole Dozier, Mayor Pro-tem
Brett Gantt, Town Council Member
Bill Jensen, Town Council Member
Audra Killingsworth, Town Council Member
Wesley Moyer, Town Council Member
Drew Havens, Town Manager

To: Future Apex Homeowner

From: Apex Town Councilman Bill Jensen

As a champion of renewable energy in Apex, I wish to personally welcome you to our town and to discuss the value to you as a homeowner for installing a solar photovoltaic (PV) system. In addition I am providing you information regarding why our town, the United States and the rest of the world must seriously work toward carbon free energy production.

The installation of a solar PV system at the time of home construction provides the best return for this type of investment. The value of the electricity produced more than off-sets the small increase in the financing costs of the home. So, the net cost of home ownership will be reduced by the addition of a solar PV system. Studies have shown that a home with a solar PV system will sell for a premium price that covers the installation cost. It is just smart home ownership to install a solar PV system during the construction phase of the home.

Table 1 following this letter provides costs and savings information to assist you in selecting a solar PV system. The following article "How to Purchase a Rooftop Solar Photovoltaic Energy System" provides a guide to your purchase. Your home builder and solar PV installer will also be able to assist you.

The United States' economy remains highly dependent on carbon based fuels, but this dependence cannot continue far into the future. Coal is plentiful, but its use has been declining due to economic pressure from natural gas and environmental concerns about the byproducts of coal ash and carbon dioxide. In 1970, the production of oil in the United States reached a high of 10 million barrels per day. Thereafter production decreased to five million barrels per day over a 35 year period. Since 2012, the fracking process of extracting oil has increased production to eleven million barrels per day, but it is likely that this value is near the peak and in the next few years oil production will again decrease. Meanwhile, The United States consumes about twenty million barrels of oil per day, leaving a shortfall of nine million barrels per day that must be imported at an economic cost. The fracking process for extracting natural gas has increased the volumetric output to an all-time high of 74 billion cubic feet per day. But, like the production of oil, the production of natural gas may have already peaked and will be declining in the next few years. Renewable energy will play an important role in providing the electric energy that will power our nation into the future. Each of us must participate in this transition to a clean renewable energy future.

From an environmental perspective, it is important that mankind reduce our dependence on carbon-based fuels. The climate change that is taking place from excess atmospheric carbon dioxide will continue to worsen and will jeopardize future generations – your children and mine. The following article "Climate Change: Atmospheric Carbon Dioxide" provides information explaining why it is important that each of us do whatever we can to reduce our carbon footprint. Installing a solar PV system will reduce your personal carbon footprint, save you money and help protect the environment for generations to come.

Again, welcome to Apex if you are a new resident, and if you are a present resident seeking a new home, thank you for remaining in our family. If I can be of any assistance, please do not hesitate to contact me.

With best wishes for a bright future,

Bill Jensen
billjensen@nc.rr.com
919 274-0926

Table 1 Costs and Savings from a Solar Photovoltaic System

System Size Kilowatts (kW) / System Area Square Feet	# of Solar Panels	Estimated Cost Before Tax Rebate	Estimated Cost After Tax Rebate	Estimated Annual Solar Energy	Estimated 1st. Year Electricity Savings	Estimated Monthly Electricity Savings	Estimated Monthly Mortgage Costs *	Estimated Net Monthly Savings	Estimated Net Yearly Savings
4.13 kW / 260 sq.ft.	14	$12,349	$8,644	5887 kWhs	$636	$53.00	$39.77	$13.23	$159
5.90 kW / 400 sq.ft.	20	$16,933	$11,853	8310 kWhs	$897	$74.75	$56.09	$18.66	$224
7.08 kW / 480 sq.ft.	24	$19,824	$13,877	9972 kWhs	$1,077	$89.75	$67.35	$22.40	$269
8.85 kW / 600 sq.ft.	30	$23,895	$16,727	12465 kWhs	$1,346	$112.17	$84.17	$28.00	$336
10.62 kW / 720 sq.ft.	36	$27,824	$19,477	14 958 kWhs	$1,615	$134.58	$100.99	$33.59	$403

* Payment based on 4.0% interest rate, 30 year mortgage

HOW TO PURCHASE A ROOFTOP SOLAR PHOTOVOLTAIC ENERGY SYSTEM

The following steps will guide you to a satisfactory purchase of a solar photovoltaic (PV) energy system. Additional information may be found at: https://www.energy.gov/energysaver/planning-home-solar-electric-system

1. The type and orientation of the rooftop is the first consideration. If the rooftop is pitched, then the orientation should face in the southern direction. Anywhere along the arc from east-south-west will work with the more southern orientations being preferred. A flat roof provides for pitched mounting assemblies that may be oriented southward. Your solar installer will evaluate the strength characteristics of the roof to ensure a safe installation. Solar PV systems may be adapted to any roof type with preference to composition shingle roofs and standing seam metal roofs. There should be minimal roof shading during the daylight hours from 10 AM until 4 PM.

2. The yearly amount of electrical energy that the building uses or is expected to use determines the system size. The system should produce approximately an equivalent amount of electric energy per year as is expected to be used within the building. If the application is on an existing building, then the electric utility's billing data will provide the kilowatt-hours used for the year. If the system is to be installed on a new building an estimate may be made from historic data on existing buildings. The solar PV installer can provide guidance in determining the expected energy utilization and system size.

3. A solar installation provider is selected in conjunction with item 4 below and the following steps. If the home is to be constructed, the developer/builder may have a relationship with one or two solar installers and have an integrated pricing program. Else, there are a number of qualified solar installers in the Apex area.

4. Request a quote(s) for the price and size of the solar PV system. Learn what type of panels and inverter are proposed for the system along with the associated guarantees. Most panels are guaranteed by the manufacturer to perform at a high production value over a 25-year period. They will likely last much longer. This information should be in the solar PV installer's quote.

5. Once the price of the solar PV system is known, the expected federal tax-credit through the 2019 tax-year will be 30% of the system price. The tax-credit reduces the purchaser's tax-liability in the amount of the credit. In effect, the federal government is paying for 30% of the system cost.

6. If the building is being constructed, the financing may be included within the home loan. Solar PV systems on existing homes may be financed through a home-improvement loan.

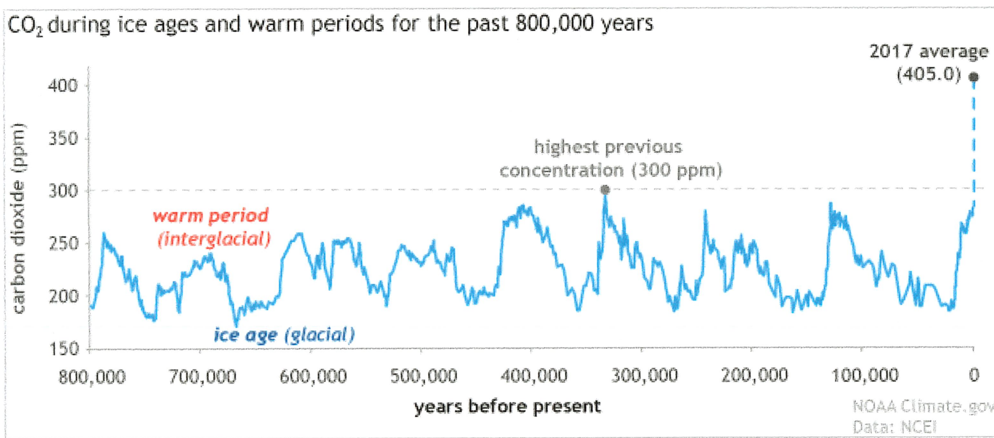
Climate.gov
science & information for a climate-smart nation

Climate Change: Atmospheric Carbon Dioxide

Author:
Rebecca Lindsey [(https://www.climate.gov/author/rebecca-lindsey)](https://www.climate.gov/author/rebecca-lindsey)

August 1, 2018

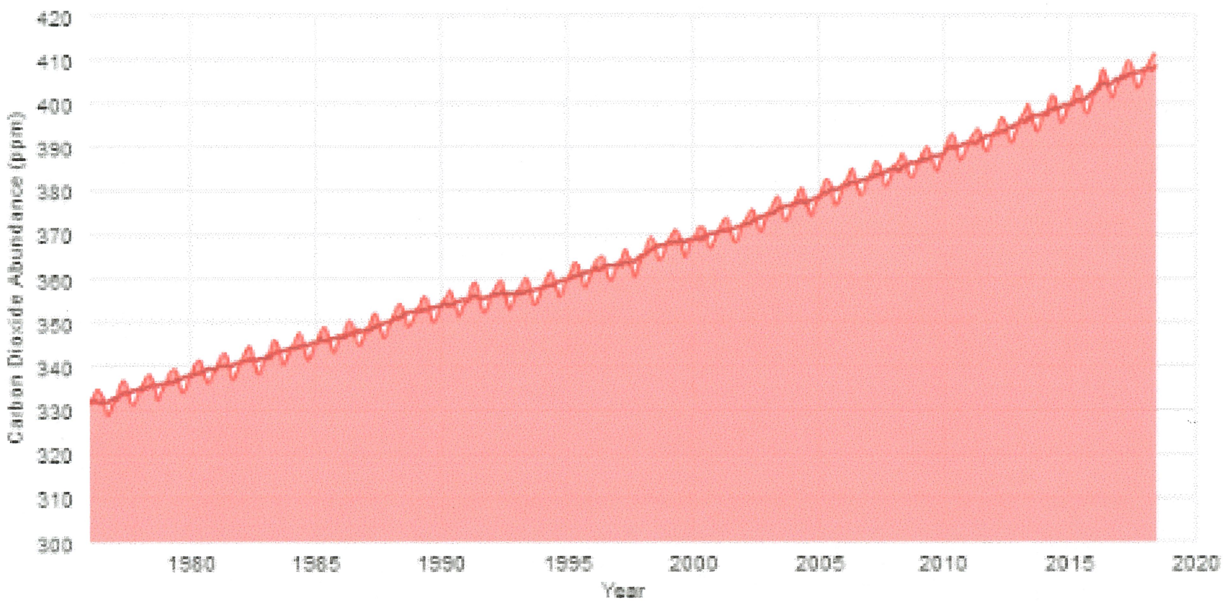
The global average atmospheric carbon dioxide in 2017 was 405.0 parts per million (*ppm* for short), with a range of uncertainty of plus or minus 0.1 ppm. Carbon dioxide levels today are higher than at any point in at least the past 800,000 years.



Atmospheric carbon dioxide concentrations in parts per million (ppm) for the past 800,000 years, based on EPICA (ice core) data. The peaks and valleys in carbon dioxide levels track the coming and going of ice ages (low carbon dioxide) and warmer interglacials (higher levels). Throughout these cycles, atmospheric carbon dioxide was never higher than 300 ppm; in 2017, it reached 405.0 ppm (black dot). NOAA Climate.gov, based on EPICA Dome C data [(http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:0::::P1_study_id:6091)](http://hurricane.ncdc.noaa.gov/pls/paleox/f?p=519:1:0::::P1_study_id:6091) (Lüthi, D., et al., 2008) provided by NOAA NCEI Paleoclimatology Program.

In fact, the last time the atmospheric CO2 amounts were this high was more than 3 million years ago, when temperature was 2°–3°C (3.6°–5.4°F) higher than during the pre-industrial era, and sea level was 15–25 meters (50–80 feet) higher than today.

Carbon dioxide concentrations are rising mostly because of the fossil fuels that people are burning for energy. Fossil fuels like coal and oil contain carbon that plants pulled out of the atmosphere through photosynthesis over the span of many millions of years; we are returning that carbon to the atmosphere in just a few hundred years.



Squeeze or stretch the graph in either direction by holding the Shift key while you click and drag. The bright red line (source data (https://www.climate.govfile://localhost/products/trends/co2/co2_mm_mlo.txt)) shows monthly average carbon dioxide at NOAA's Mauna Loa Observatory on Hawai'i in parts per million (ppm): the number of carbon dioxide molecules per million molecules of dry air. Over the course of the year, values are higher in Northern Hemisphere winter and lower in summer. The dark red line shows the annual trend, calculated as a 12-month rolling average.

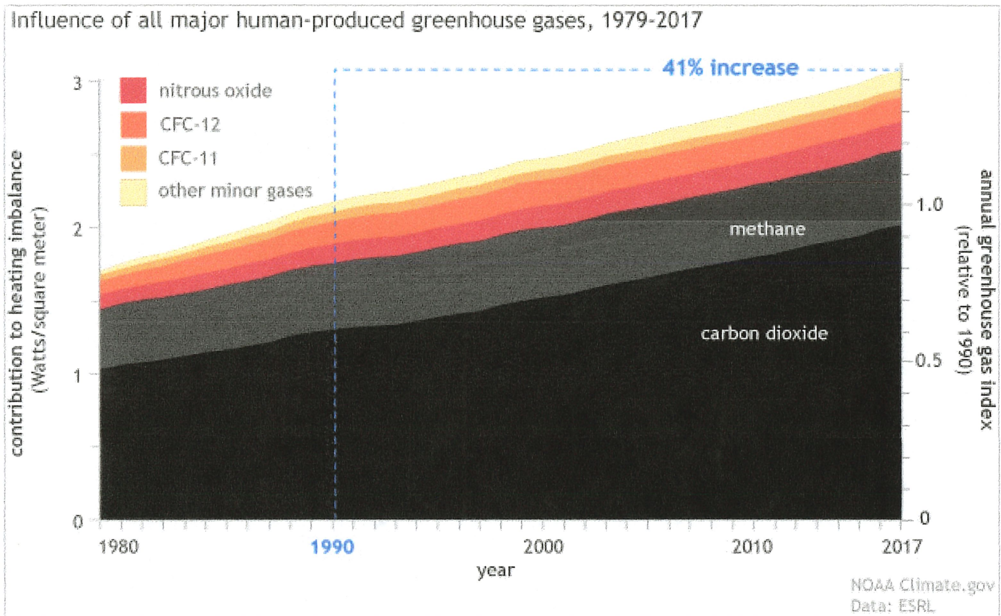
According to the *State of the Climate in 2017* (https://www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/state-of-the-climate/) report from NOAA and the American Meteorological Society, global atmospheric carbon dioxide was 405.0 ± 0.1 ppm in 2017, a new record high. Between 2016 and 2017, global annual mean carbon dioxide increased 2.2 ± 0.1 ppm, which was slightly less than the increase between 2015 and 2016 (3.0 ppm per year).

In the 1960s, the global growth rate of atmospheric carbon dioxide was roughly 0.6 ± 0.1 ppm per year. Over the past decade, however, the growth rate has been closer to 2.3 ppm per year. The annual rate of increase in atmospheric carbon dioxide over the past 60 years is about 100 times faster than previous natural increases, such as those that occurred at the end of the last ice age 11,000-17,000 years ago.

Why carbon dioxide matters

Carbon dioxide is a greenhouse gas (https://www.climate.gov/news-features/understanding-climate/climate-change-annual-greenhouse-gas-index): a gas that absorbs heat. Warmed by sunlight, Earth's land and ocean surfaces continuously radiate thermal infrared energy (heat). Unlike oxygen or nitrogen (which make up most of our atmosphere), greenhouse gases absorb that heat and release it gradually over time, like bricks in a fireplace after the fire goes out. Without this natural greenhouse effect (https://www.koshland-science-museum.org/explore-the-science/interactives/what-is-the-greenhouse-effect), Earth's average annual temperature would be below freezing instead of close to 60°F. But increases in greenhouse gases have tipped the Earth's energy budget out of balance, trapping additional heat and raising Earth's average temperature.

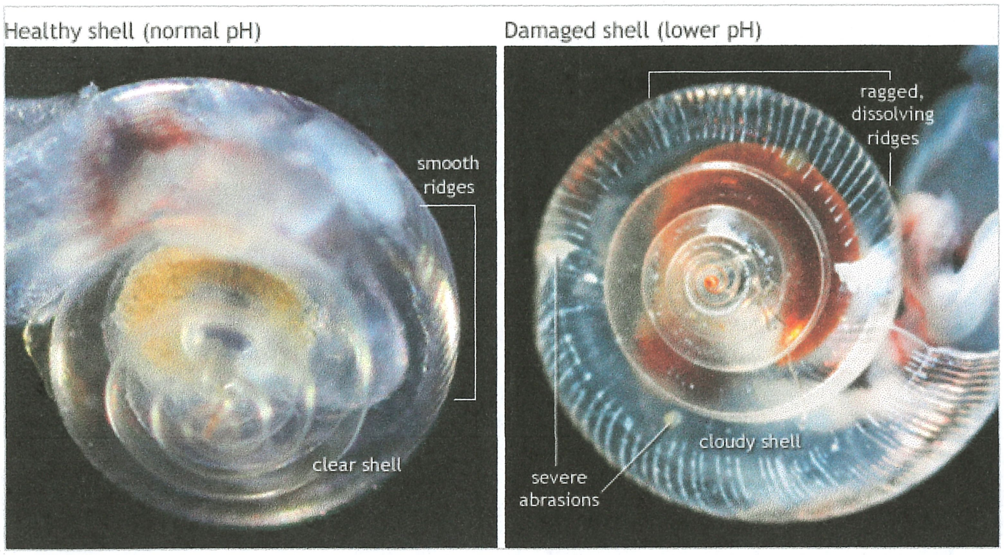
Carbon dioxide is the most important of Earth's long-lived greenhouse gases (https://www.climate.gov/news-features/understanding-climate/climate-change-annual-greenhouse-gas-index). It absorbs less heat per molecule than the greenhouse gases methane or nitrous oxide, but it's more abundant and it stays in the atmosphere much longer. And while carbon dioxide is less abundant and less powerful than water vapor on a molecule per molecule basis, it absorbs wavelengths of thermal energy that water vapor does not, which means it adds to the greenhouse effect in a unique way. Increases in atmospheric carbon dioxide are responsible for about two-thirds of the total energy imbalance that is causing Earth's temperature to rise.



*(**left vertical axis**) The heating imbalance in watts per square meter relative to the year 1750 caused by all major human-produced greenhouse gases: carbon dioxide, methane, nitrous oxide, chlorofluorocarbons 11 and 12, and a group of 15 other minor contributors. Today's atmosphere absorbs about 3 extra watts of incoming solar energy over each square meter of Earth's surface. According to NOAA's Annual Greenhouse Gas Index (**right axis**) the combined heating influence of all major greenhouse gases has increased by 41% relative to 1990. NOAA Climate.gov graph, based on data (https://www.esrl.noaa.gov/gmd/aggi/aggi.html) from NOAA ESRL.*

Another reason carbon dioxide is important in the Earth system is that it dissolves into the ocean like the fizz in a can of soda. It reacts with water molecules, producing carbonic acid and lowering the ocean's pH. Since the start of the Industrial Revolution, the pH of the ocean's surface waters has dropped from 8.21 to 8.10. This drop in pH is called *ocean acidification* (http://www.whoi.edu/OCB-OA/page.do?pid=112076).

A drop of 0.1 may not seem like a lot, but the pH scale is logarithmic; a 1-unit drop in pH means a tenfold increase in acidity. A change of 0.1 means a roughly 30% increase in acidity. Increasing acidity interferes with the ability of marine life to extract calcium from the water to build their shells and skeletons.



(left) A healthy ocean snail has a transparent shell with smoothly contoured ridges. (right) A shell exposed to more acidic, corrosive waters is cloudy, ragged, and pockmarked with 'kinks' and weak spots. Photos (https://www.climate.gov/news-features/featured-images/ocean-acidity-dissolving-tiny-snails%E2%80%99-protective-shell) *courtesy Nina Bednarsek, NOAA PMEL.*

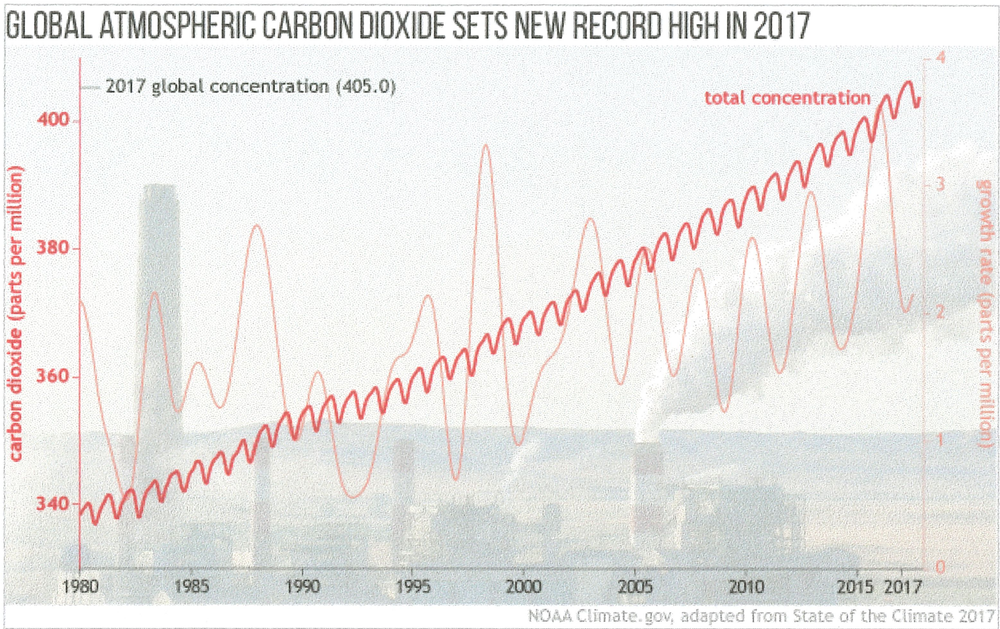
Past and future carbon dioxide

Natural increases in carbon dioxide concentrations have periodically warmed Earth's temperature during ice age cycles over the past million years or more. The warm episodes (interglacials) began with a small increase in sunlight due to a tiny wobble in Earth's axis of rotation or in the path of its orbit around the Sun.

That little bit of extra sunlight caused a little bit of warming. As the oceans warmed, they outgassed carbon dioxide —like a can of soda going flat in the heat of a summer day. The extra carbon dioxide in the atmosphere amplified the initial warming.

Based on air bubbles trapped in mile-thick ice cores (https://www.climate.gov/news-features/climate-tech/climate-core-how-scientists-study-ice-cores-reveal-earth%E2%80%99s-climate) (and other paleoclimate evidence), we know that during the ice age cycles of the past million years or so, carbon dioxide never exceeded 300 ppm. Before the Industrial Revolution started in the mid-1700s, the global average amount of carbon dioxide was about 280 ppm.

By the time continuous observations began at Mauna Loa Volcanic Observatory in 1958, global atmospheric carbon dioxide was already 315 ppm. On May 9, 2013, the daily average carbon dioxide measured at Mauna Loa surpassed 400 ppm for the first time on record. Less than two years later, in 2015, the global amount went over 400 ppm for the first time.



Monthly carbon dioxide in the global atmosphere (dark red line) from 1980–2017 showing the long-term increase along with the smaller ups and downs due to seasonal plant growth and decay. The light red line is the annual growth rate, or the amount by which carbon dioxide increased each year. NOAA Climate.gov graphic adapted from Figure 2.45a in State of the Climate in 2017. The graphs are overlaid on a photo (https://flic.kr/p/cGKH6Q) of Dave Johnson Power Plant in Wyoming by Greg Goebel, used under a Creative Commons (https://creativecommons.org/licenses/by-sa/2.0/) license.

If global energy demand continues to grow and to be met mostly with fossil fuels, atmospheric carbon dioxide will likely exceed 900 ppm by the end of this century.

More on carbon dioxide

NOAA carbon dioxide observations (https://www.esrl.noaa.gov/gmd/ccgg/trends/)

Carbon cycle factsheet (https://earthobservatory.nasa.gov/Features/CarbonCycle/)

Carbon dioxide emissions by country over time (http://www.globalcarbonatlas.org/en/CO2-emissions)

Comparing greenhouse gases by their global warming potential (https://www.epa.gov/ghgemissions/understanding-global-warming-potentials)

References

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Highlights:

- Human activities have increased the natural concentration of carbon dioxide in our atmosphere, amplifying Earth's natural greenhouse effect.
- The global average amount of carbon dioxide hit a new record high in 2017: 405.0 parts per million.
- The annual rate of increase in atmospheric carbon dioxide over the past 60 years is about 100 times faster than previous natural increases, such as those that occurred at the end of the last ice age 11,000-17,000 years ago.

Reviewer:

Ed Dlugokencky