

## Lessening the effects of or adapting to climate change will require coordinated action by citizens, corporations, and governments all over the world.

- CO<sub>2</sub> remains in the atmosphere for a very long time. This has two impacts:
  - Regardless of source, CO<sub>2</sub> disperses throughout Earth's atmosphere, giving a relatively uniform concentration everywhere.
  - The atmosphere is a true "commons" in which all people share the impacts of CO<sub>2</sub> no matter how much or little they emit.
- CO<sub>2</sub> emissions = population × energy use.
  - Global population continues to grow.
  - People everywhere strive for better living standards, which means greater energy use.
  - To minimize the impacts, energy must be obtained with little or no CO<sub>2</sub> emissions.
- The amount of CO<sub>2</sub> being emitted globally is so large that no single country can solve the problem alone. All must work together.
  - Because the developed world has contributed the bulk of the CO<sub>2</sub> currently in the atmosphere, it should lead the way to a lower CO<sub>2</sub> future.
  - Because the developing world has a large population deserving of higher living standards, its development must be fueled by new, greener, and more efficient energy technologies to avoid catastrophic warming.
- New and improved energy systems are required to reduce CO<sub>2</sub> emissions.
  - Improvements are needed in technologies that do not use fossil fuels, such as wind, solar, wave, geothermal, and nuclear power.
  - Power grids need modernization to take full advantage of wind and solar power.
  - Energy storage systems must be improved.
  - Methods to capture and store CO<sub>2</sub> from fossil fuel power plants need further development to increase reliability and reduce costs.
- We must place a price on CO<sub>2</sub> emissions that reflects their impact on Earth. This will allow the marketplace to drive the development of new and improved energy systems.

## Things You Can Do

- Educate yourself about climate change and energy systems.
- Talk about climate change to neighbors, friends, and family.
- Get involved!
  - Join an organization advocating for change in our energy policies.
  - Write letters to the editor.
  - Call or write your elected officials about the need for action at the state, national, and international levels to limit the emission of CO<sub>2</sub> from fossil fuels.
  - Support efforts to put a price on carbon consistent with its global impacts.
- Drive less, but when you do drive, use a vehicle that has the best mileage possible.
- Use alternative transportation when possible.
- Reduce your use of energy at home.
  - Weatherize your home. This minimizes your heating and cooling energy needs and their costs.
  - Use Energy Star appliances.
  - Change to LED lights.
  - Adjust your thermostat.
  - Use less hot water.
- Install solar panels on your home.
- Plant trees.
- Eat less meat, especially beef, and cheese.

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<http://www.carbontracker.org/>

<https://openknowledge.worldbank.org/handle/10986/11860>

<https://openknowledge.worldbank.org/handle/10986/14000>

<https://www.pwc.co.uk/services/sustainability-climate-change/insights/low-carbon-economy-index.html>

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## Climate Action Alliance of the Valley

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## The Need for Action on Climate Change Is Urgent!



Climate Action Alliance of the Valley

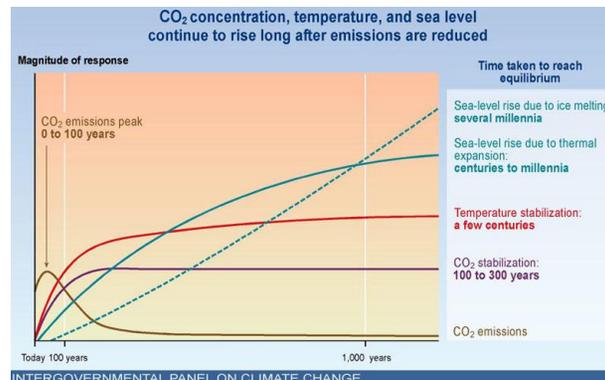
Harrisonburg, VA

## Driven mainly by carbon dioxide (CO<sub>2</sub>) emissions, Earth's climate is changing.

- Evidence from diverse sources confirms climate change.
  - Atmospheric temperature reconstructions show that current warming is unprecedented within the span of human civilization.
  - Oceans are warming.
  - Glaciers are melting.
  - Sea level is rising.
  - The Arctic ice cap is shrinking, the ice is thinning, and its nature is changing.
  - Although East Antarctic ice is increasing, West Antarctic ice is decreasing much faster.
  - Weather is getting more extreme.
  - Ecosystems are changing more rapidly.
- Evidence for the role of CO<sub>2</sub> as the main cause of climate change is very strong.
  - Earth's temperature is stabilized and regulated by the greenhouse effect.
  - The major greenhouse gases (GHGs) are CO<sub>2</sub> and water vapor.
  - Water vapor is responsible for 50% of the greenhouse effect, but its life in the atmosphere is short because it condenses as rain and snow. CO<sub>2</sub> is directly responsible for 20% of the greenhouse effect, but its indirect effect is much larger. Because it does not condense, it stays in the atmosphere for a very long time, thereby influencing the water vapor content and regulating Earth's temperature. It is Earth's thermostat.
  - The level of CO<sub>2</sub> in the atmosphere is increasing because of the burning of fossil fuels (coal, oil, and natural gas).
  - Satellites show a reduction in outgoing (i.e., cooling) radiation leaving Earth at the wavelengths associated with CO<sub>2</sub> and other GHGs.
  - Land-based sensors show an increase in incoming (i.e., warming) radiation from CO<sub>2</sub> and other GHGs consistent with their increased concentration in the atmosphere.

## We must release less CO<sub>2</sub> each year to stabilize Earth's climate.

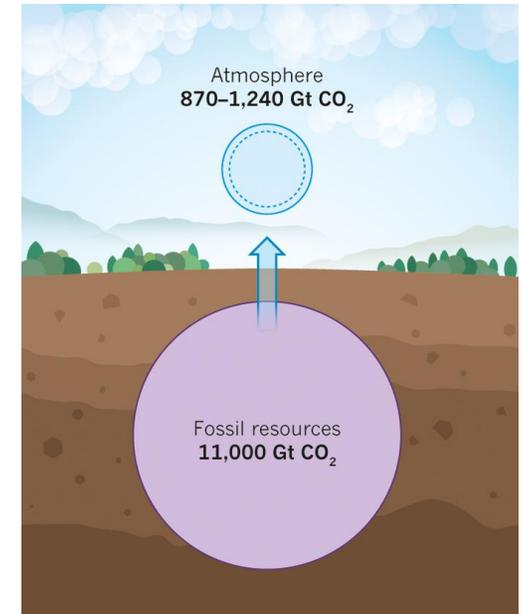
- Although not without consequences, international agreements have set 3.6 °F as a tolerable global average temperature rise above preindustrial (1750) levels. A greater increase will have greater consequences.
  - To have a 60% chance of keeping the temperature increase below 3.6 °F, we can only release 2900 gigatonnes (Gt) of CO<sub>2</sub> to the atmosphere.
  - We have already released 1900 Gt, leaving 1000 Gt that may be discharged.
  - The global CO<sub>2</sub> release rate is currently 36 Gt/yr and increasing.
  - **At the current discharge rate, we'll reach our tolerable CO<sub>2</sub> limit by 2039!**
  - The more CO<sub>2</sub> we release, the more Earth's temperature will rise, with greater consequences.
- Stabilizing Earth's temperature will require a long time after CO<sub>2</sub> emissions are decreased.



- The longer we wait to lower CO<sub>2</sub> emission rates, the longer it will take for Earth's climate to stabilize.
- Global CO<sub>2</sub> emissions must be decreased by 6.2%/yr from now until 2100 if the increase in global average temperature is to be limited to 3.6 °F. The current rate of decrease is only around 1%/yr. Each year we delay increases the size of the required yearly decrease.

## Continuing to burn fossil fuels could be catastrophic for humanity.

- The greater the amount of CO<sub>2</sub> emitted by burning fossil fuels, the higher Earth's temperature will rise and the worse the impacts will be.
- The amount of CO<sub>2</sub> that would be released by burning all fossil fuel reserves far exceeds the safe limits on emissions. The results of burning all fossil fuels would be disastrous.



M. Jakob and J. Hilaire, *Nature*, 517, 150, 2015

- About 80% of coal, 50% of gas, and 30% of oil reserves must be left in the ground to limit the temperature increase to 3.6 °F.
- Fossil fuel reserves are currently worth around \$27 trillion.
  - The reserves would have no economic value if left in the ground.
  - Fossil fuel companies and their investors are understandably reluctant to embrace the move to carbon-free energy sources.
- How to move away from fossil fuels without damaging the global economy is a difficult challenge that must be solved quickly.