

A faint, light gray world map is visible in the background, centered behind the text.

CARBON DIOXIDE AND CLIMATE CHANGE

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CARBON DIOXIDE (CO₂)- THE MOST ABUNDANT GREEN HOUSE GAS IN EARTH'S ATMOSPHERE

- The Earth needs CO₂ to keep its surface inhabitable, for without CO₂ and other greenhouse gases, all the heat from Sun will be reflected back out to space. Earth's crust would just been a frozen land.
- The term greenhouse gases mean that gas insulate Earth's surface just like the glass ceiling of greenhouses which lets light pass through, and absorbs heat and traps heat to create an environment for plants to grow inside the greenhouse.
- CO₂ along with other greenhouse gases, keeps the heat from the sun on Earth. About 84% of heat reflects back on Earth by greenhouse gases in the atmosphere.

(Constello, 2013, Accessed May 23, 2018)

PATHS OF ENERGY WITHOUT GREENHOUSE GASES

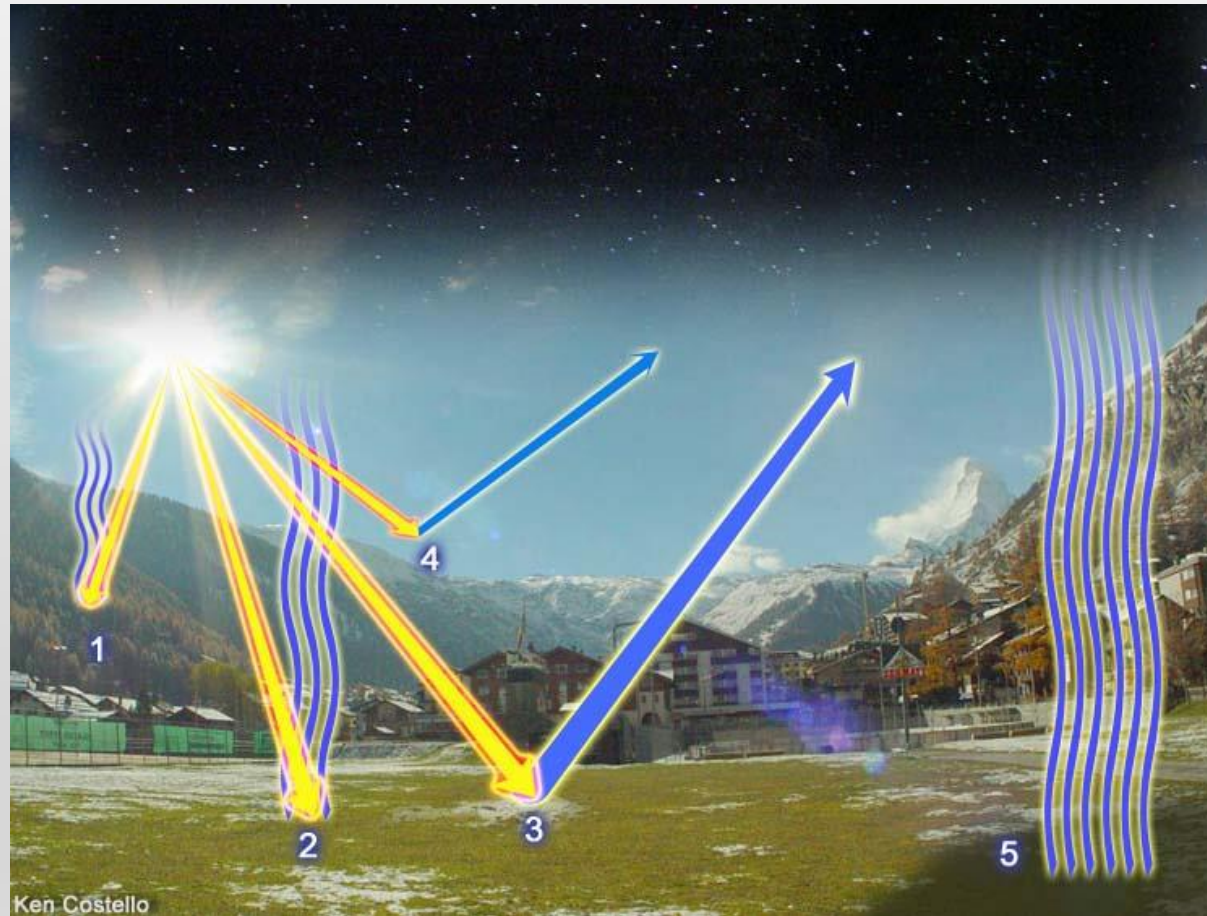


FIG.1: "FOLLOW THE PATHS THAT ENERGY TAKES", GLOBAL WARMING:TUTORIAL #E1: BALANCING HEAT & COLD, BY KEN CONSTELLO,
[HTTP://WWW.CHEMISTRYLAND.COM/CHM107/GLOBALWARMING/GLOBALWARMING.HTML](http://www.chemistryland.com/CHM107/GLOBALWARMING/GLOBALWARMING.HTML),
MAR20, 2013

PATH OF ENERGY WITH GREENHOUSE GASES

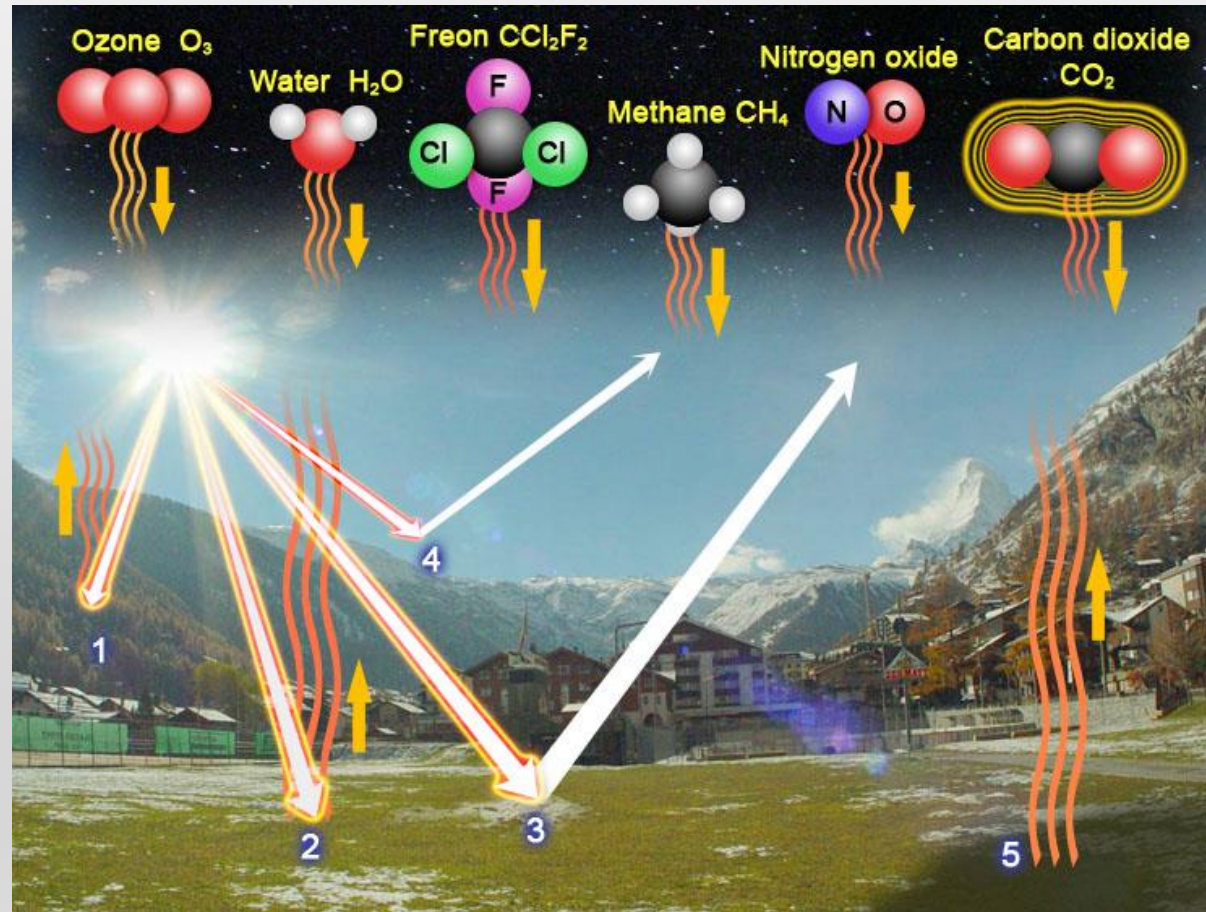


FIG.2: "FOLLOW THE PATHS THAT ENERGY TAKES", GLOBAL WARMING:TUTORIAL #E1: BALANCING HEAT & COLD, BY KEN CONSTELLO,
[HTTP://WWW.CHEMISTRYLAND.COM/CHM107/GLOBALWARMING/GLOBALWARMING.HTML](http://www.chemistryland.com/CHM107/GLOBALWARMING/GLOBALWARMING.HTML),
MAR20, 2013

EXCESS CARBON DIOXIDE

- Before 1800, the Carbon cycle works perfectly. Plants and algae breathe in CO₂ and released O₂. Then the rest of the living organism do the opposite, and the cycle repeats and balances itself over and over again.
- “But since the beginning of the Industrial Revolution in 1800 up until 2005, the level of atmospheric carbon dioxide has risen from about 280ppm to about 394ppm in 2013, a 40% increase.” (Basic Chemistry, pg. 84, Accessed May 23, 2018)
- And....we have just hit a new record: CO₂ has reached 410ppm in April 2018. (Rice, 2018. Accessed May 25, 2018)

A BREIF EXPLANATION OF WHY BURNING FOSSIL FUEL PRODUCES CO₂

- Burning fossil fuel is also known as hydrocarbon combustion, because fossil fuel or its counterparts (petroleum, coal, etc.) composed of hydrogen and carbon.
- Fossil fuel combustion is the only way to obtain energy, and the end results of the combustion reaction always produces water, energy, and CO₂.
- Oxygen is from the air. When we burn fossil fuel, we released carbon into the air to bond with oxygen in the atmosphere.

General Formula of fossil fuel combustion reaction:



(Basic Chemistry, pg. 237, Accessed May 31, 2018)

CARBON CYCLE

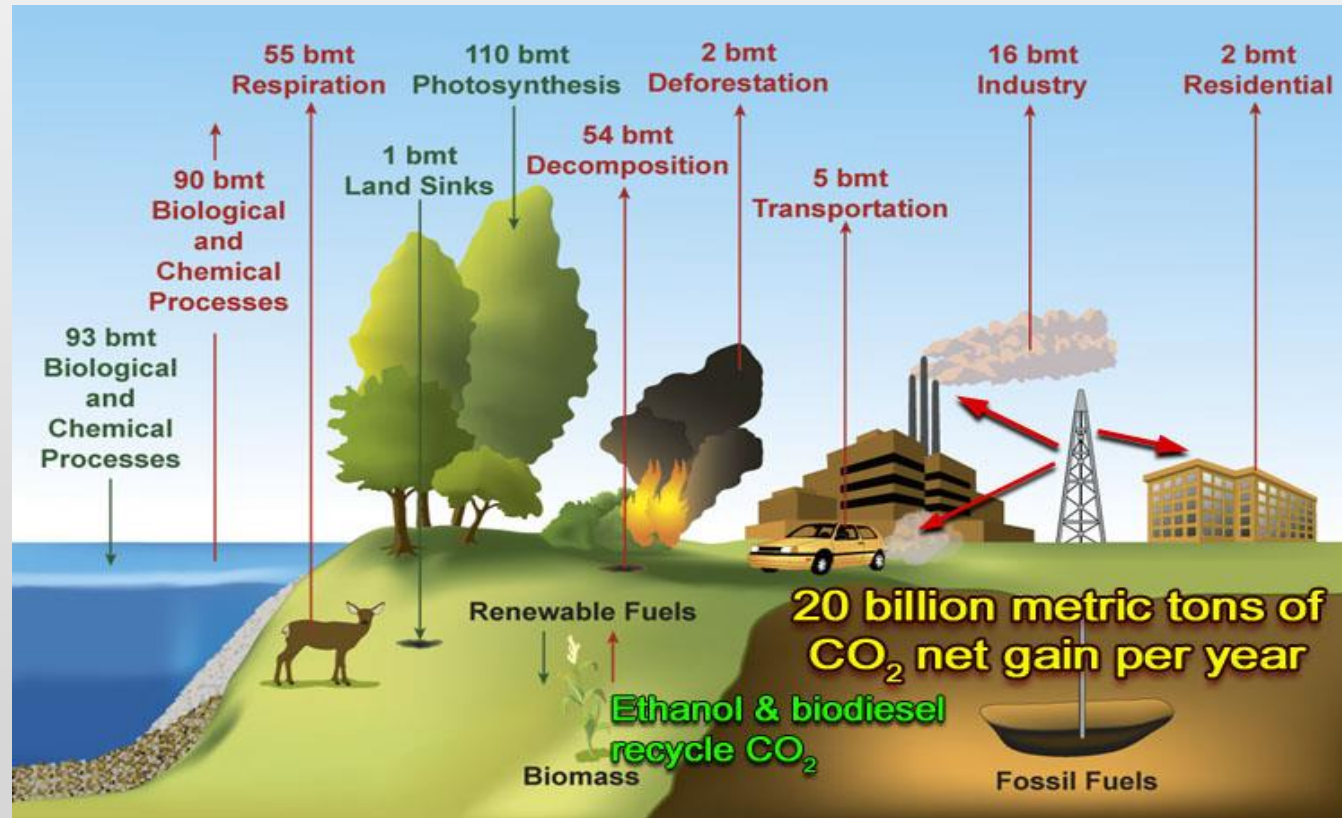


FIG.3: "CARBON CYCLE", GLOBAL WARMING:TUTORIAL #E1: BALANCING HEAT & COLD, BY KEN CONSTELLO,
[HTTP://WWW.CHEMISTRYLAND.COM/CHM107/GLOBALWARMING/GLOBALWARMING.HTML](http://www.chemistryland.com/CHM107/GLOBALWARMING/GLOBALWARMING.HTML),
MAR20, 2013

THE DISASTROUS CONSEQUENCES OF GLOBAL WARMING

- With 20bmt of CO2 net gain each year, more heat is being trapped in the atmosphere, and hence, results in global warming.
- Disastrous Consequences of Global Warming, to name a few:
 - Extreme Weather Events
 - Sea Level rises and Ocean acidification
 - Plant and animal migration, bringing along “new” diseases
 - Downfall of Agriculture

(Braddford and Pappas, 2017. Accessed May 25, 2018)

EXTREME WEATHER EVENTS



FIG.4: "EXTREME WEATHER AND CLIMATE", DATA ASSIMILATION AND PREDICTION, [HTTP://DA.CIRA.COLOSTATE.EDU/RESEARCH/EXTREME-WEATHER-AND-CLIMATE](http://da.cira.colostate.edu/research/extreme-weather-and-climate), 2017

SEA LEVEL RISES AND OCEAN ACIDIFICATION

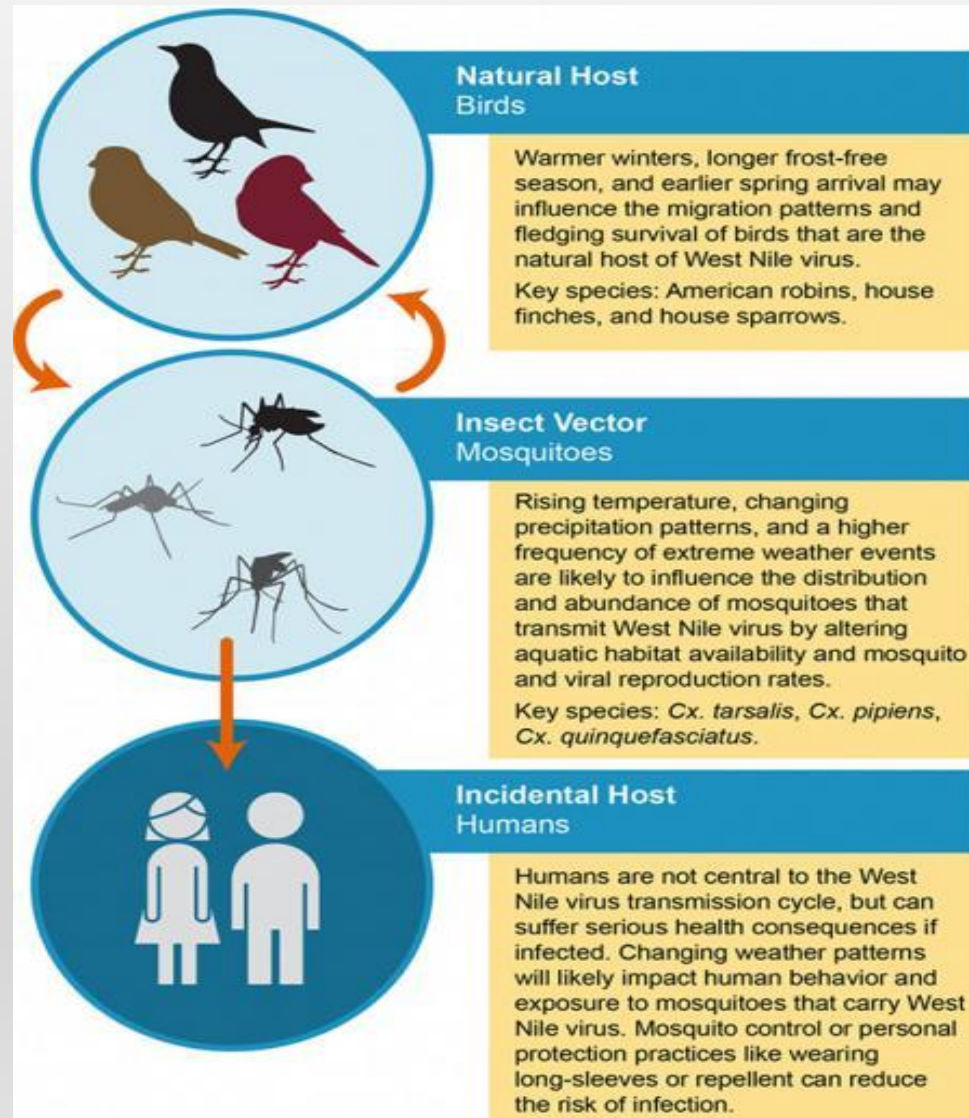


<https://www.youtube.com/watch?v=xE0KtLy5j8w>



FIG.6: "BLEACHING KILLS 35 PER CENT OF CORALS IN GREAT BARRIER REEF", TVI, [HTTP://TVI.COM.PK/BLEACHING-KILLS-35-PER-CENT-OF-CORALS-IN-GREAT-BARRIER-REEF/](http://TVI.COM.PK/BLEACHING-KILLS-35-PER-CENT-OF-CORALS-IN-GREAT-BARRIER-REEF/), MAY 31, 2016

ANIMAL MIGRATION PATTERN SHIFTS AND NEW EPIDEMICS



For example: West Nile Disease

FIG.7: "WEST NILE EXPLAINED", VECTORBORNE DISEASES, BY EPA, [HTTPS://19JANUARY2017SNAPSHOT.EPA.GOV/CLIMATE-IMPACTS/CLIMATE-IMPACTS-HUMAN-HEALTH_.HTML](https://19JANUARY2017SNAPSHOT.EPA.GOV/CLIMATE-IMPACTS/CLIMATE-IMPACTS-HUMAN-HEALTH_.HTML), JAN 13, 2017

UNSUSTAINABLE AGRICULTURE PRACTICE?



FIG.8: "THIS IS ABOUT EFFECTS OF GLOBAL WARMING ON AGRICULTURE WITH PICTURE",
WIKIPEDIA, BY ASAMOAH FRANCIS,
[HTTPS://COMMONS.WIKIMEDIA.ORG/WIKI/FILE:GLOBAL_WARMING_AFFECTING_GLOBAL_AGRICULTURE_AND_FOOD_SECURITY.PDF](https://commons.wikimedia.org/wiki/File:Global_Warming_Affecting_Global_Agriculture_and_Food_Security.pdf), FEB 19, 2014

SOLUTIONS?

- Reduced our personal carbon footprint?
 - Take public transit, cycling,
 - Live closer to work
 - Go Vegetarian, or even vegan
 - Forgo plastic products
 - Forgo petroleum products
 - Shop Local, buy local
 - Energy saving practices at home
 - Install solar panel on the roof of your home

Does it add up much to the present CO2 cycle?

REMEMBER:

Residential emits only 2bmt of CO2 annually, transportation is 5bmt.
Let's assume we can completely reduced the above CO2 emissions
(absolutely impossible, but let's just assumed.)

A total of 20bmt of excess CO2 per year minus 2bmt of residential CO2
emission, and 5bmt of transportation CO2 emission, equals:

$$20\text{bmt} - 2\text{bmt} - 5\text{bmt} = 13\text{bmt}$$

**13bmt of CO2 emission in excess per year
remains!**

Problems remain unresolved



BIOCHAR

- A rediscovered solution for excess CO₂ emissions. Idea borrowed from ancient South American, and Japanese agricultural practice.
- Biochar is a “High carbon content, charcoal-like material.” (airterra, 2018. Accessed May 25, 2018)
- Biochar is created by the method called pyrolysis: heating decomposing bodies of plants and animals in a low oxygen, or oxygen-free environment.
- Biochar then is placed into the soil to entrap the carbon into the soil.
- The Carbon within the Biochar doesn't have a chance to react to oxygen; therefore, the carbon will remain in the ground to nourish the plants, and crops for at least 100years.
- Note: airterra is a Canadian green company in Calgary. They sell green, organic fertile soil, and solutions to have richer soil for plant growth, such as biochar.

(airterra, 2018. Accessed May 25, 2018)

- The process of biochar production yields bio-oils and synthesis gases, which if biochar is widely used, these by-products could replace some, if not all of the energy source that is dependent on fossil fuel. (IBI, 2018. Accessed May 25, 2018)

IF WE CAN REDUCED CO2 USING BIOCHAR...

- Recall from Constello's Carbon Cycle diagram, decomposition produced 54bmt of CO2 per year.
- Recall from Constello's Carbon Cycle diagram, the total net gain of CO2 per year is 20bmt.
- If we are able to just using biochar process to manage about <40% of the World's decomposition – that is 20bmt out of 54bmt (37%).

- $\underline{20\text{bmt} - 20\text{bmt} = 0\text{bmt}}$

WE'VE FOUND A VIABLE SOLUTION!!!



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