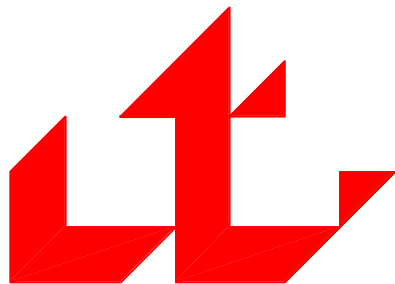


October 2019

Climate ACTION for Engineers



NSPE Webinar Series



James A. D'Aloisio
P.E., SECB, LEED AP

Klepper, Hahn & Hyatt

(315) 446-9201
jad@khpc.com

Structural Engineering
Landscape Architecture
Building Envelope Systems

Presenter Bio – Jim D’Aloisio

BSCE, Rensselaer Polytechnic Institute

Principal, Klepper, Hahn & Hyatt

P.E. in NY and MA SECB LEED AP

Member, NYSSPE, ASCE, SEAoNY

Chair, SEI Climate Action Team

Former Chair, SEI Sustainability Committee

Former Chair USGBC NY Upstate Chapter

Former USGBC National Board Member

Member, Climate Reality Leadership Corps

Trainer, Urban Green Council Energy Code

Thermographer, consulting & forensic engineer

Climate Action for Engineers

Webinar Series

Part 1 – Anthropogenic Climate Change Overview

Thursday 9 October 2019

Part 2 - Categories of Action

Thursday 23 October 2019

Part 3 - Structural and Infrastructure Mitigation

Thursday 30 October 2019

All Webinars 2:00 – 3:30 PM Eastern Time

Learning Objectives

1. Understand how and why increased levels of CO₂ and other gases increases the temperature of the atmosphere, land, and oceans.
2. Realize the consistency of international data sets that show global temperatures are increasing.
3. Acknowledge the variety of human reactions to anthropogenic climate change.
4. Compare and contrast mitigation and adaptation measures.

Climate Action for Engineers

Webinar Series

Part 1 – Anthropogenic Climate Change Overview

This session will start with a brief overview of anthropogenic climate change (ACC) - the Greenhouse effect, definition of terms, breakdown of atmospheric greenhouse gases, verifiable data, and historic trends, followed by a review of recent events. Then we'll look at some of the sociological and cultural underpinnings of the various perspectives of climate change, and how they influence perceptions of the problem. We'll discuss actions at the global, national, and local levels that relate to climate change. Then we'll begin to quantify the influence of various materials and activities and other sources of greenhouse gases.

OUTLINE - Part 1

Climate Action for Engineers:

Anthropogenic Climate Change Overview

1. What we know and what we don't
2. Cultural perspectives
3. Current trends and market shifts
4. Carbon pricing – cost vs. benefits
5. Summary

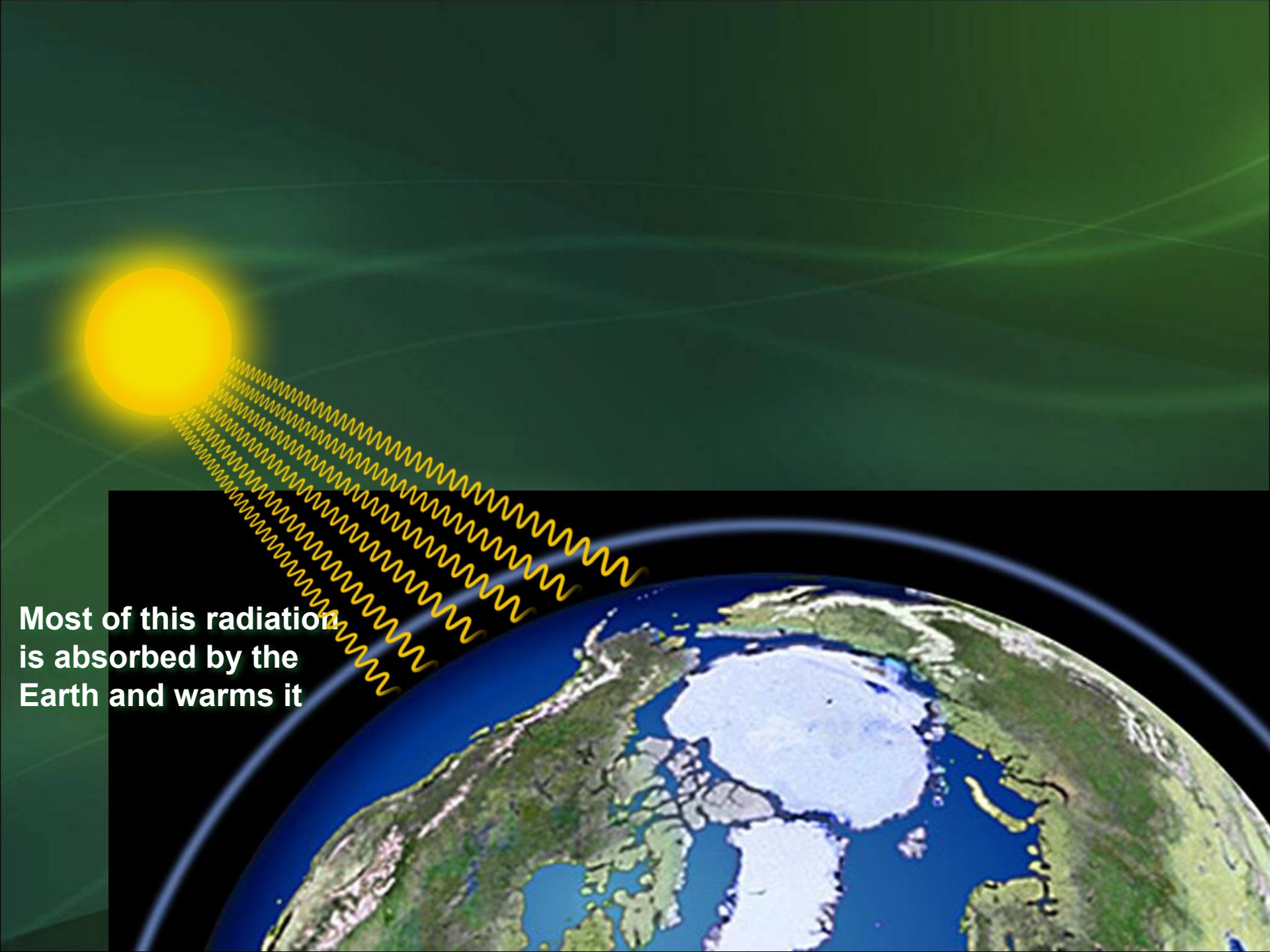
1. **What We Know** **... and what we don't**

Some Terms

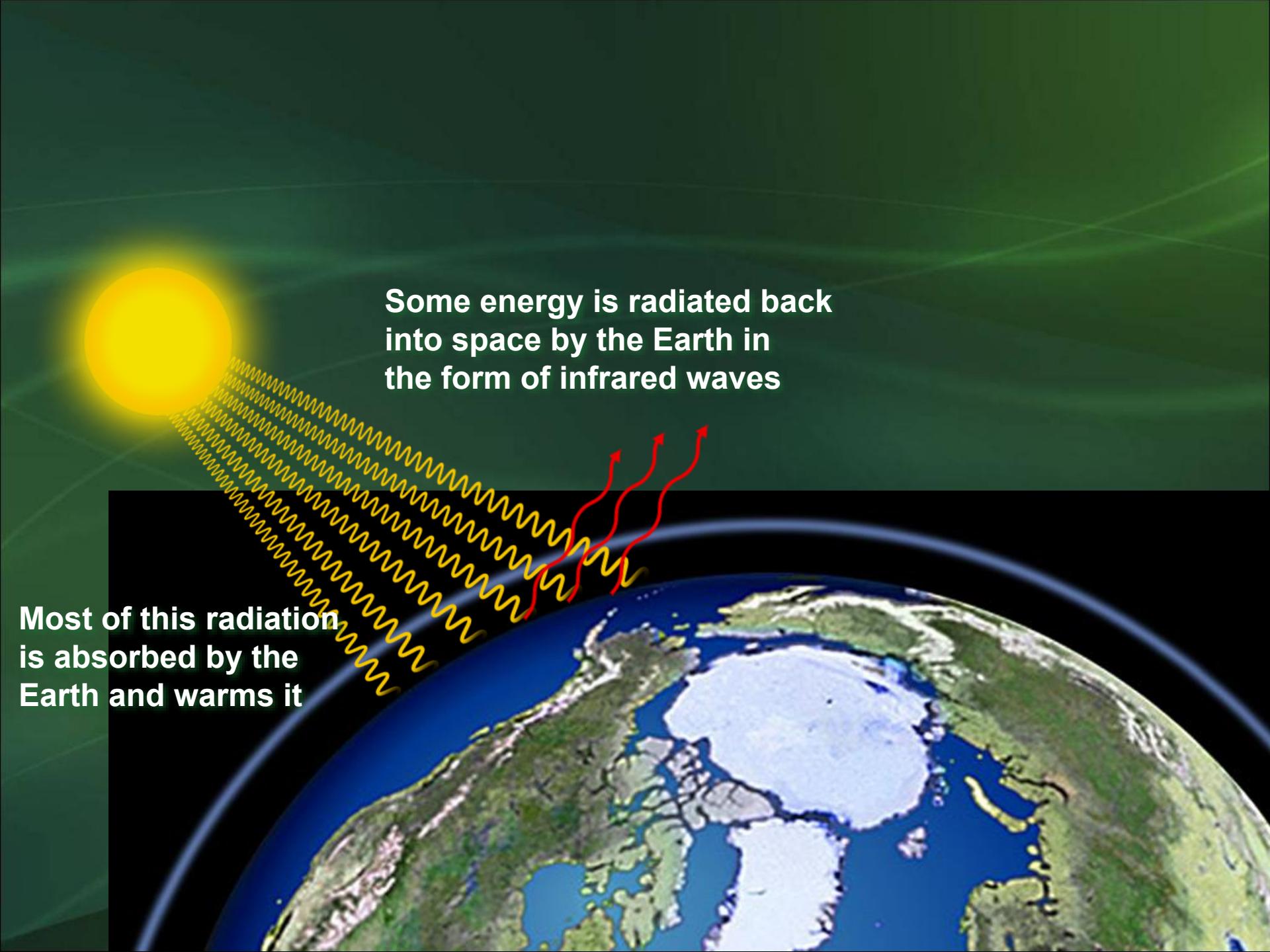
- Climate Change
- Anthropogenic Climate Change (ACC)
- Global Warming
- Anthropogenic Global Warming
- Global Warming Potential (GWP) Gases
- Carbon Dioxide Equivalent (CO₂eq)
- Global Weirding
- Climate Science

**Solar radiation
in the form of
lightwaves
passes through the
atmosphere**



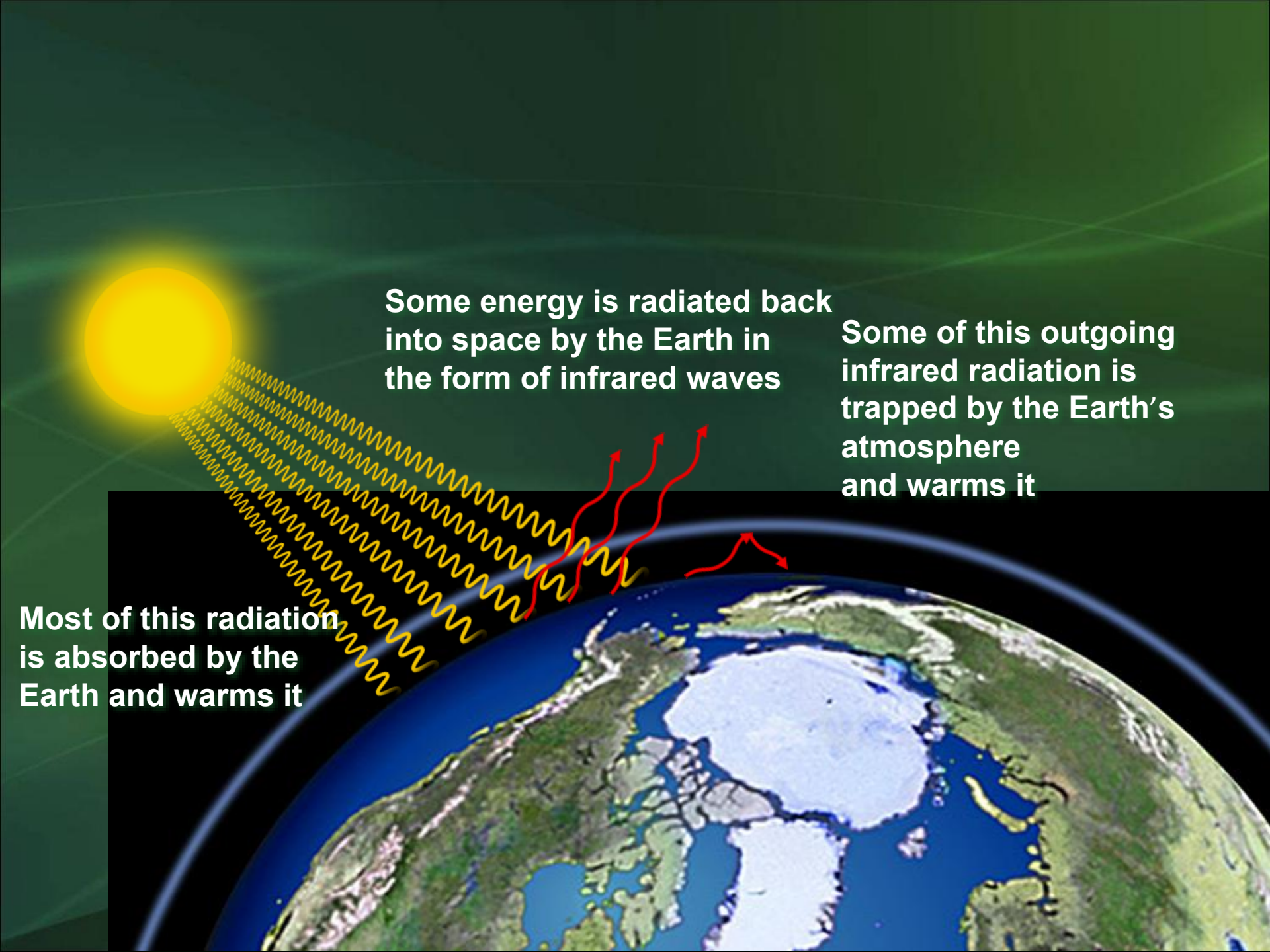


Most of this radiation is absorbed by the Earth and warms it

The diagram illustrates the greenhouse effect. On the left, a bright yellow sun emits parallel yellow wavy lines representing solar radiation towards the Earth. The Earth is shown from a perspective that includes the Arctic region, with green landmasses and blue oceans. From the Earth's surface, three red wavy lines with arrows pointing away from the planet represent infrared radiation being emitted into space. The background is a dark green gradient with faint white lines.

Some energy is radiated back into space by the Earth in the form of infrared waves

Most of this radiation is absorbed by the Earth and warms it



Some energy is radiated back into space by the Earth in the form of infrared waves

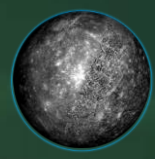
Some of this outgoing infrared radiation is trapped by the Earth's atmosphere and warms it

Most of this radiation is absorbed by the Earth and warms it



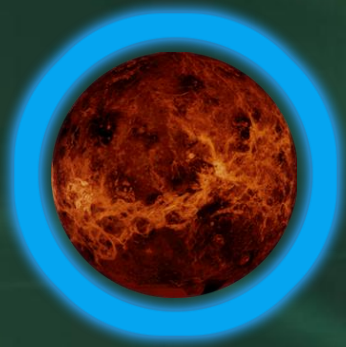
Mercury

167° C



Venus

+457° C

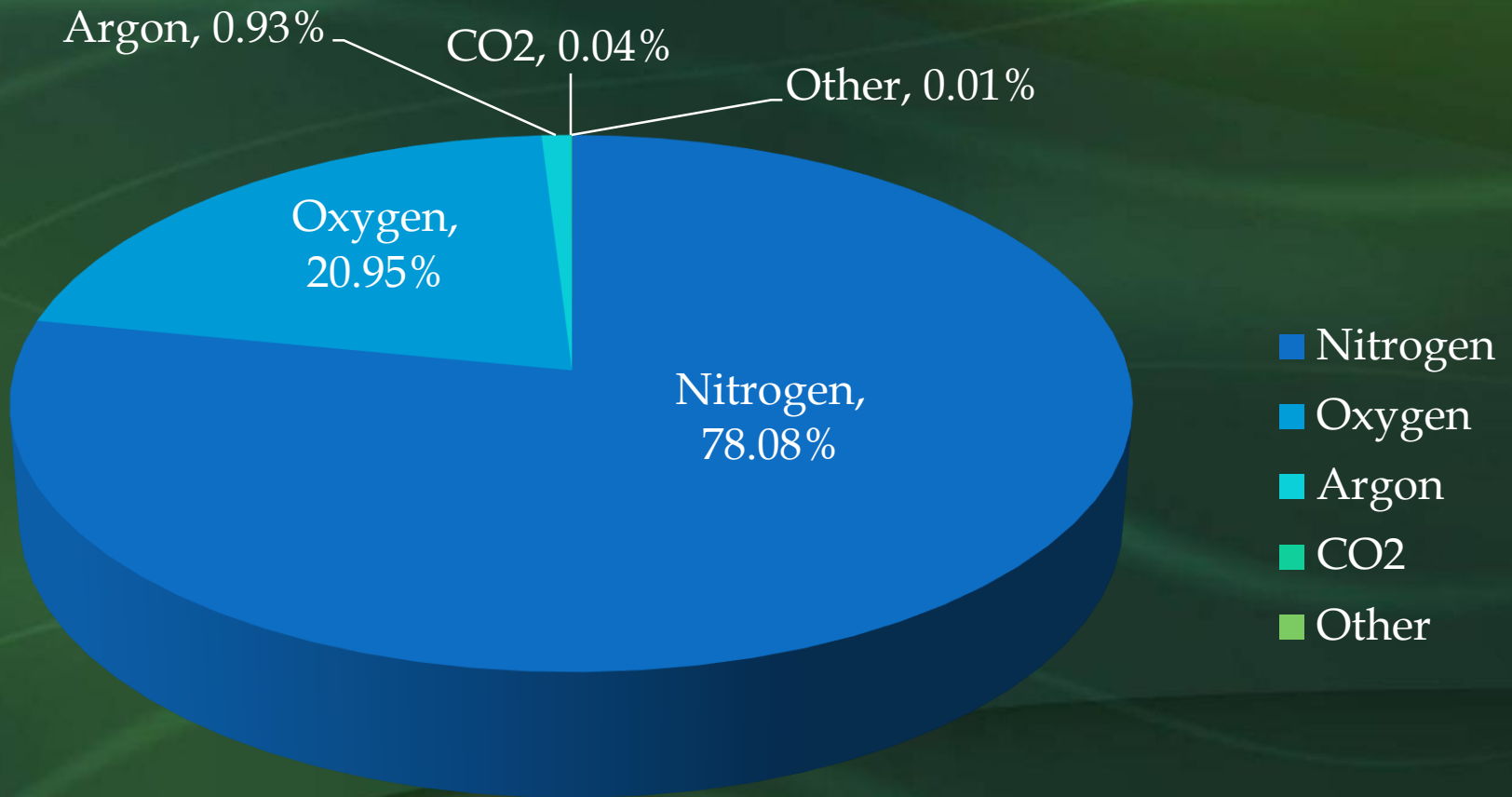


Earth

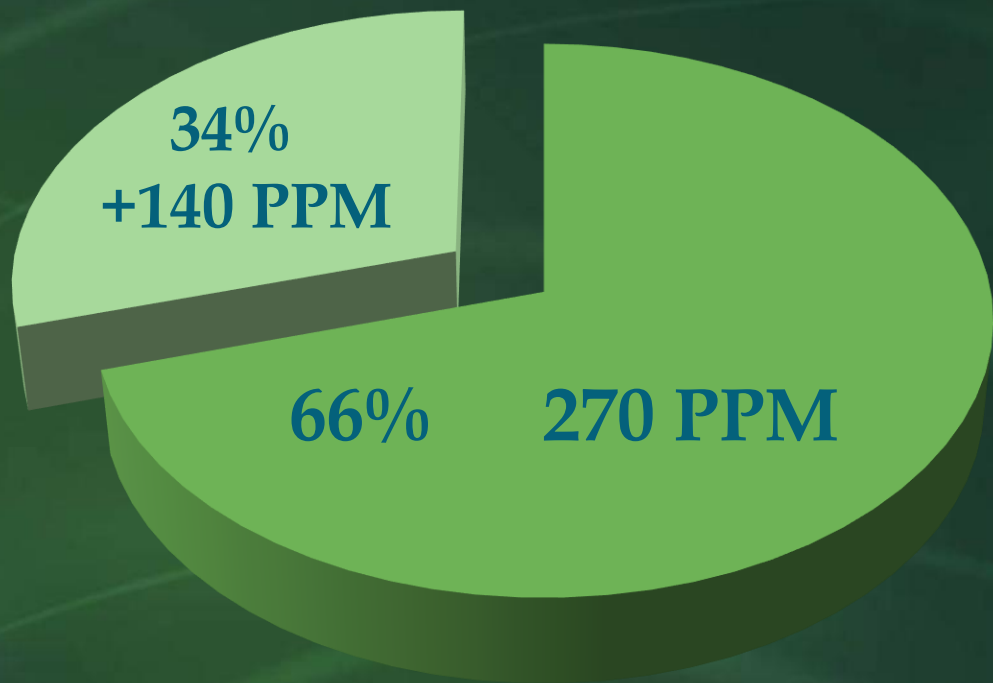
15° C



Composition of the Atmosphere



CO₂ Increase Since 1800's



■ Prior to 1800's

■ Added 1800's-2018

270 ppm to 410 ppm = 52% increase in CO₂

Global Carbon Emissions from Fossil Fuels



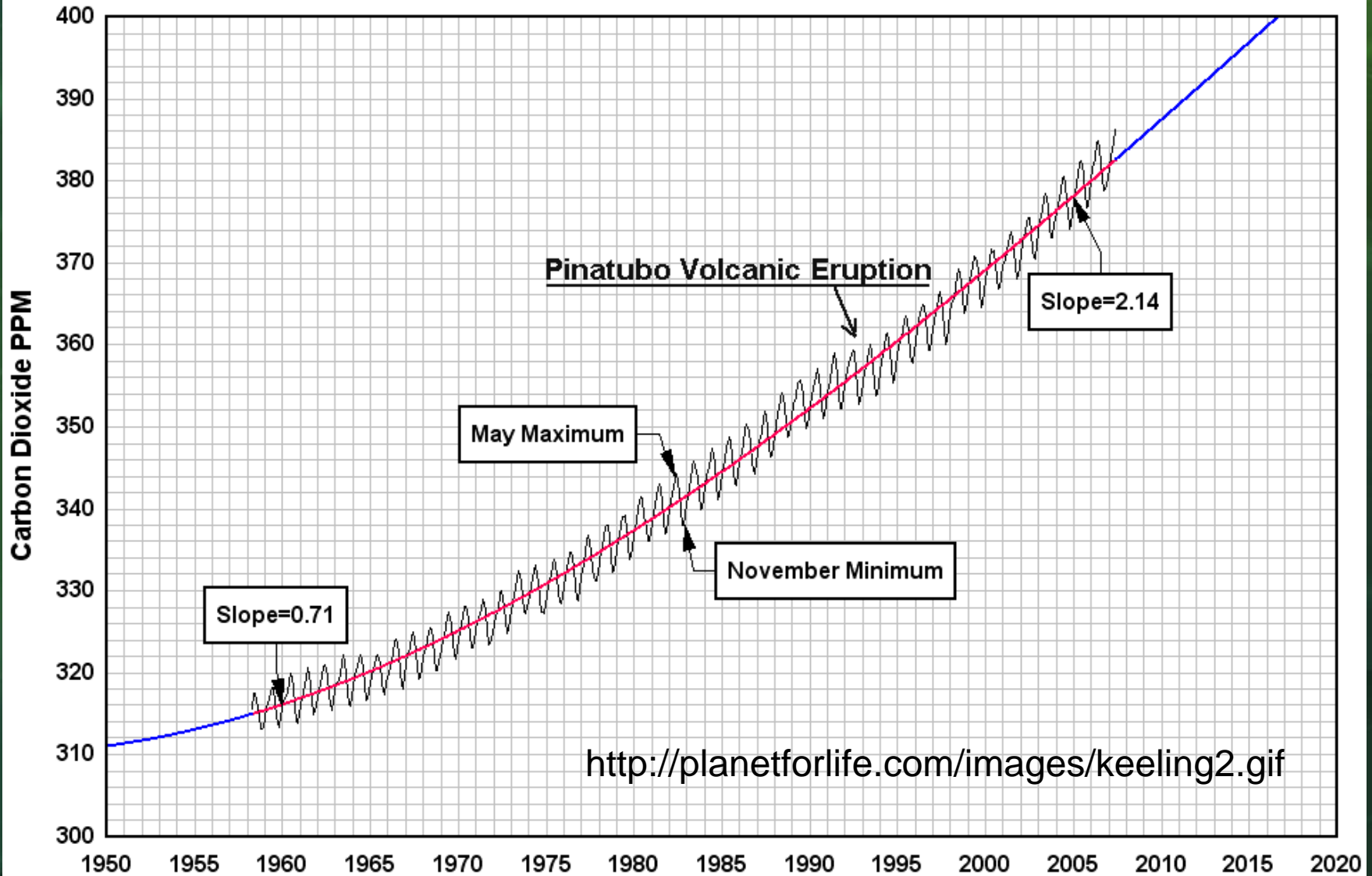
110 Million Tons of global warming gases
emitted by human activities every day...





The Keeling Curve – Atmospheric CO₂

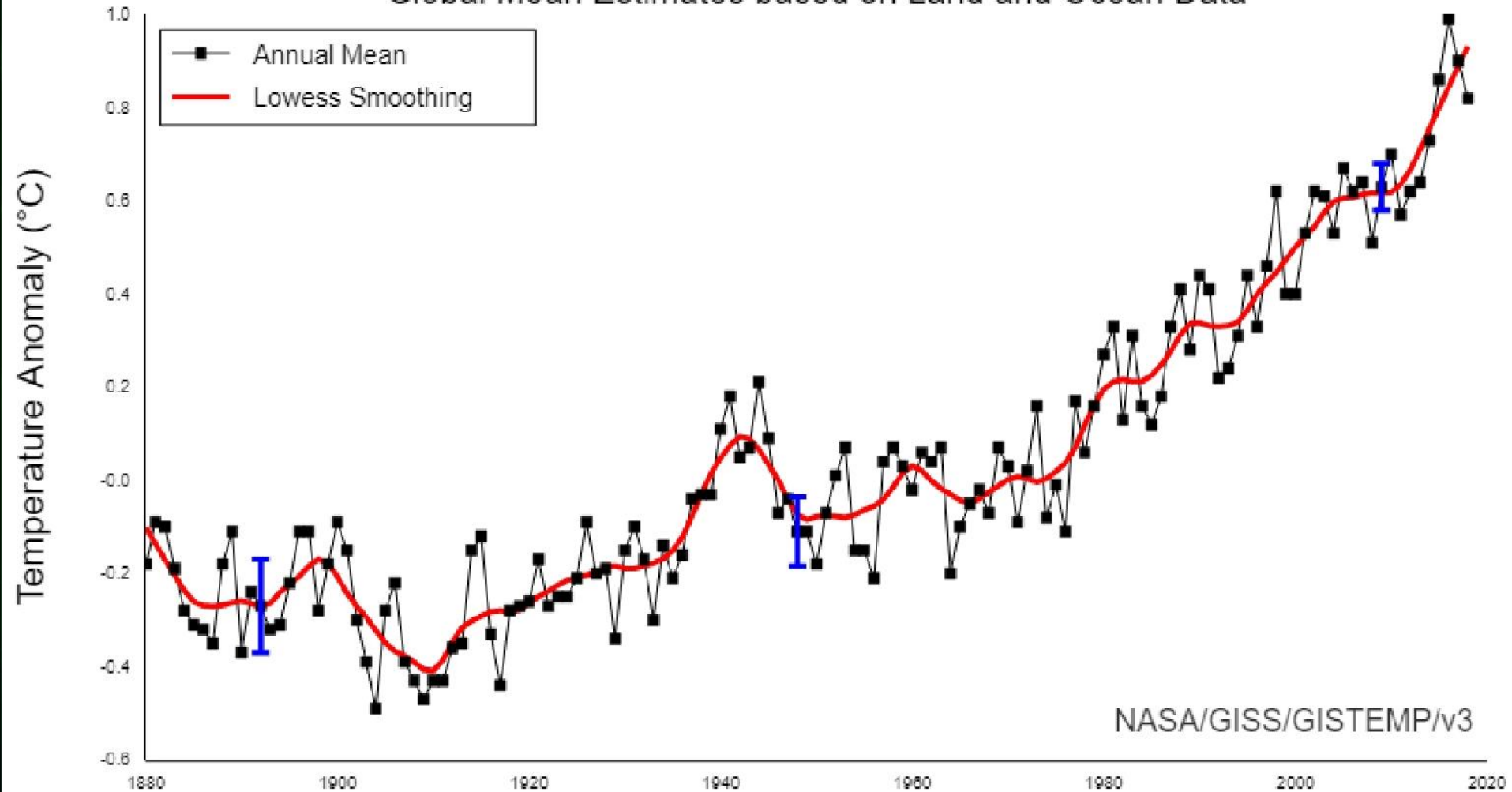
Atmospheric Carbon Dioxide During the Past 50 Years



Updated Temperature Information - 2018

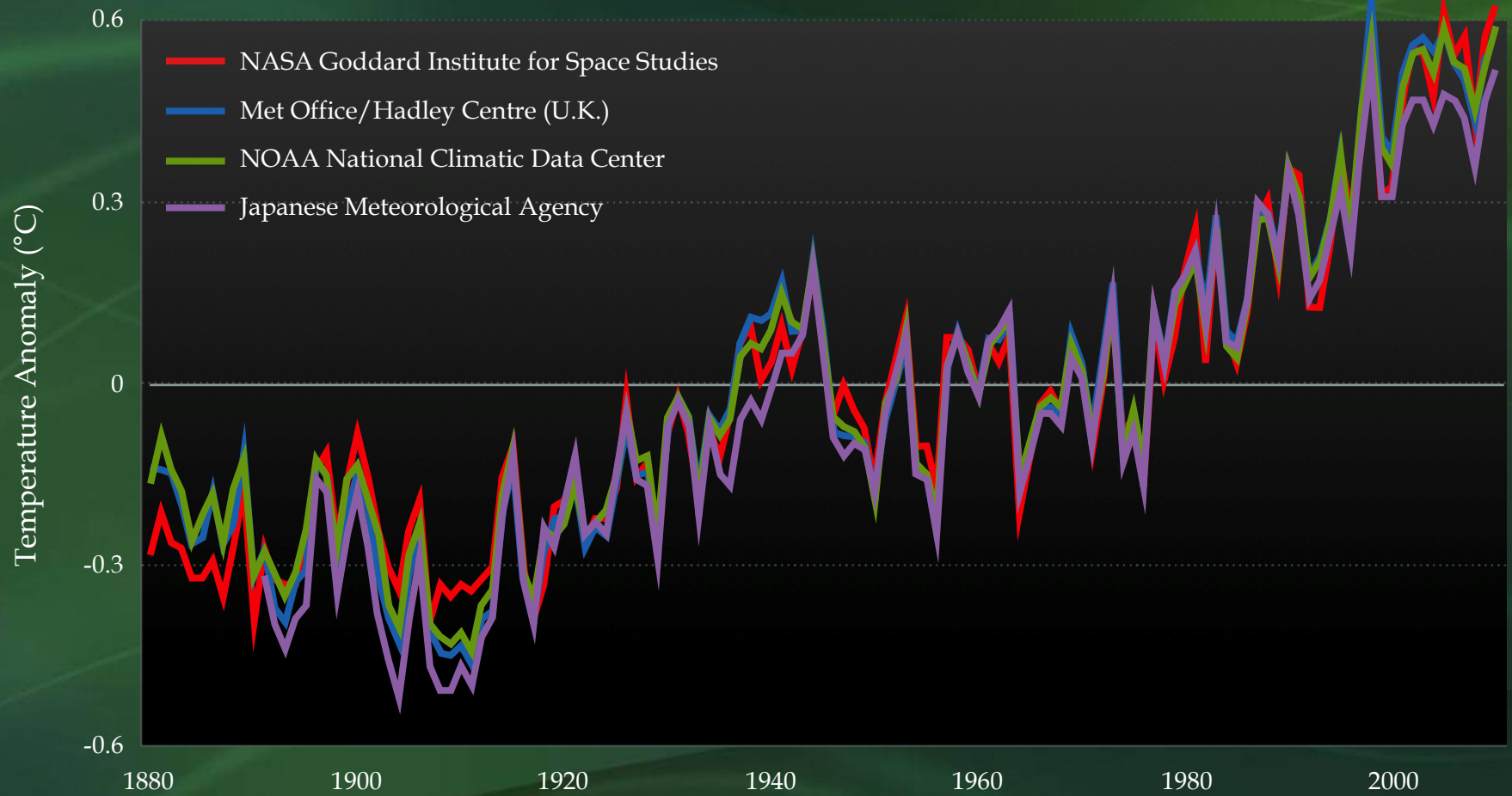
NASA's Goddard Institute for Space Studies

Global Mean Estimates based on Land and Ocean Data



Global Surface Temperatures

■ The Four Major Independent Records

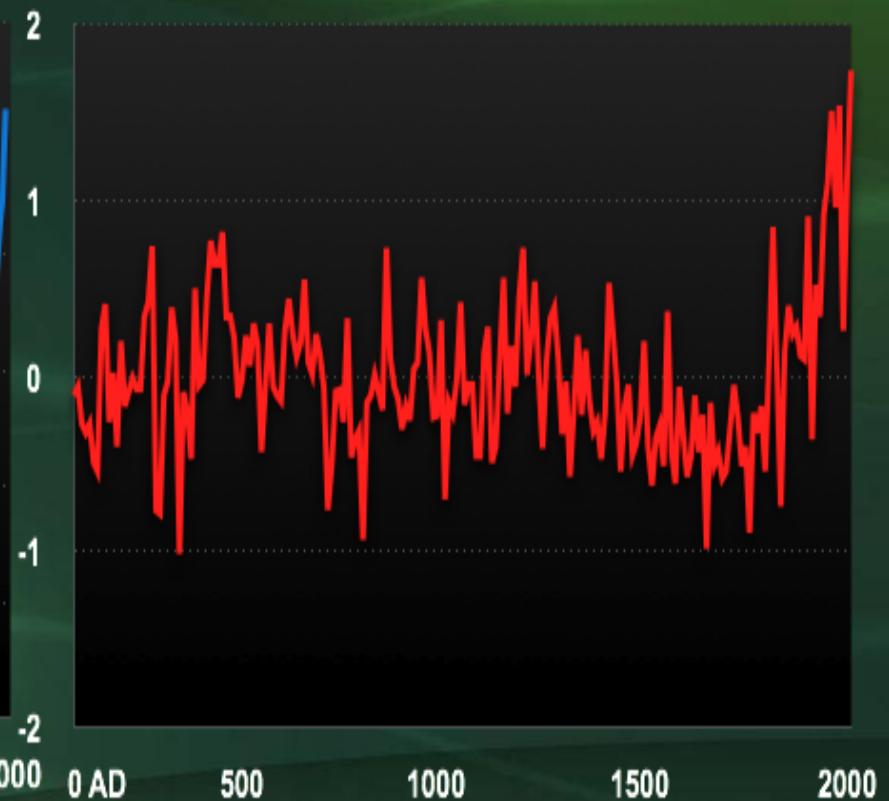


2000 Years of CO₂ and Global Temperature

CO₂ Concentration

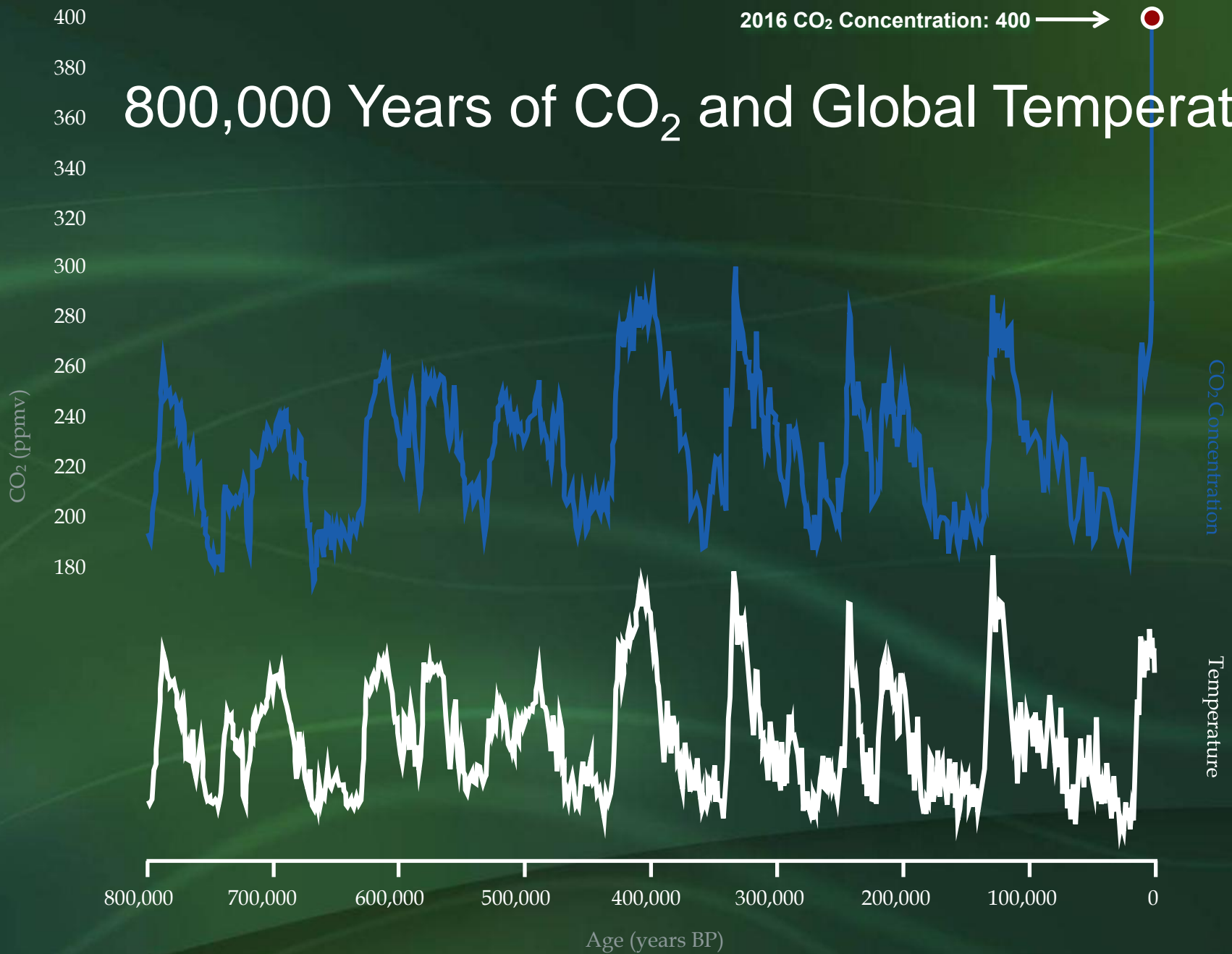


Temperature



800,000 Years of CO₂ and Global Temperature

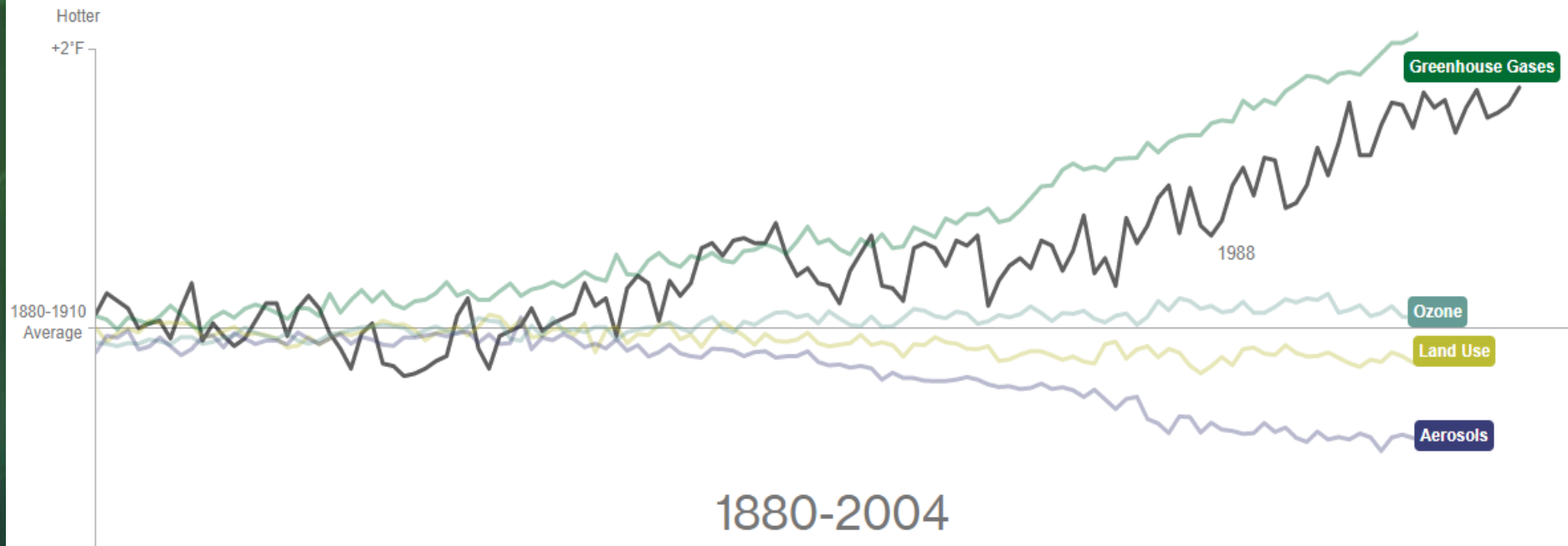
2016 CO₂ Concentration: 400 →



What's Warming the World?

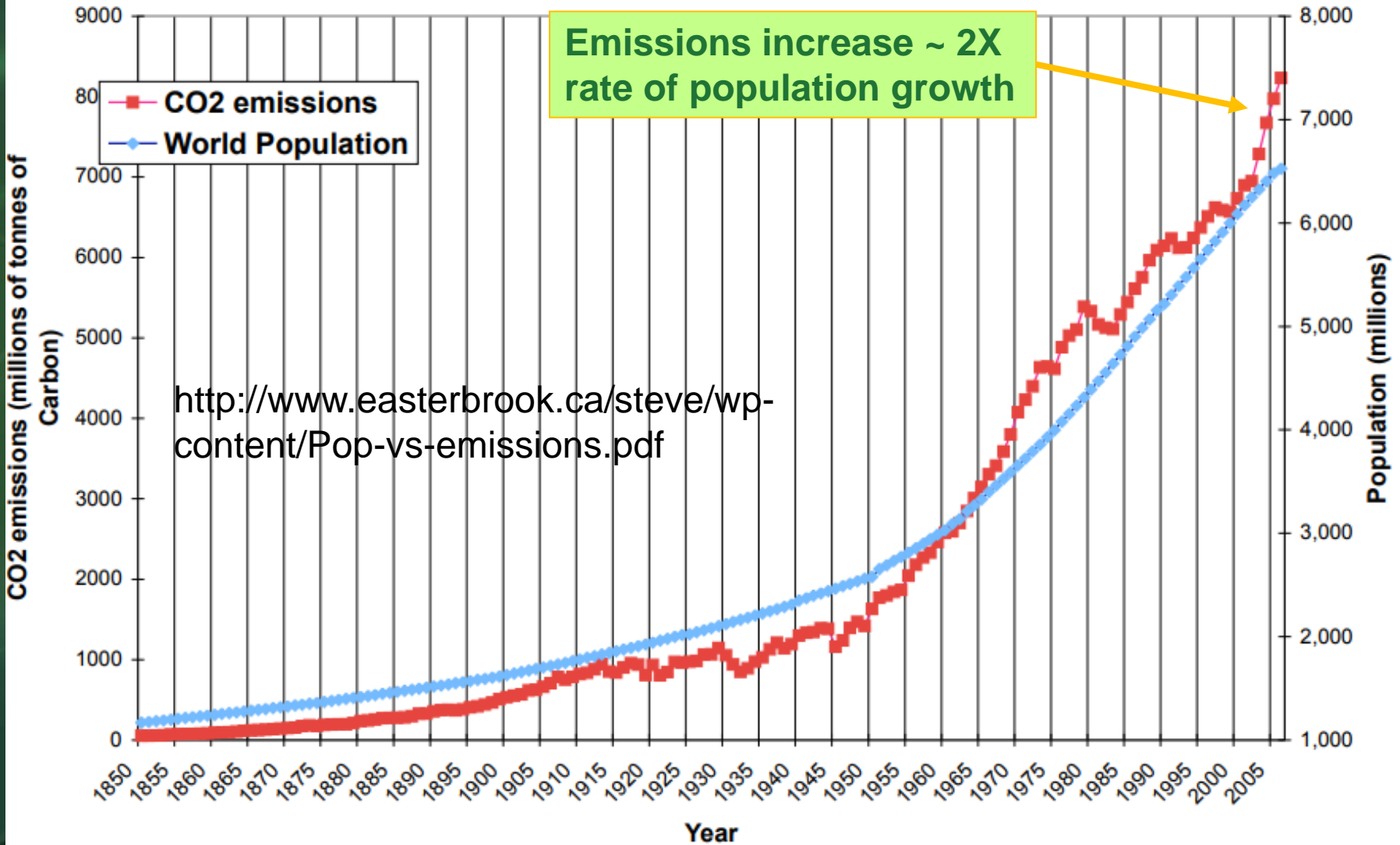
See for Yourself

Greenhouse gases warm the atmosphere. Aerosols cool it a little bit. Ozone and land-use changes add and subtract a little. Together they match the observed temperature, particularly since 1950.

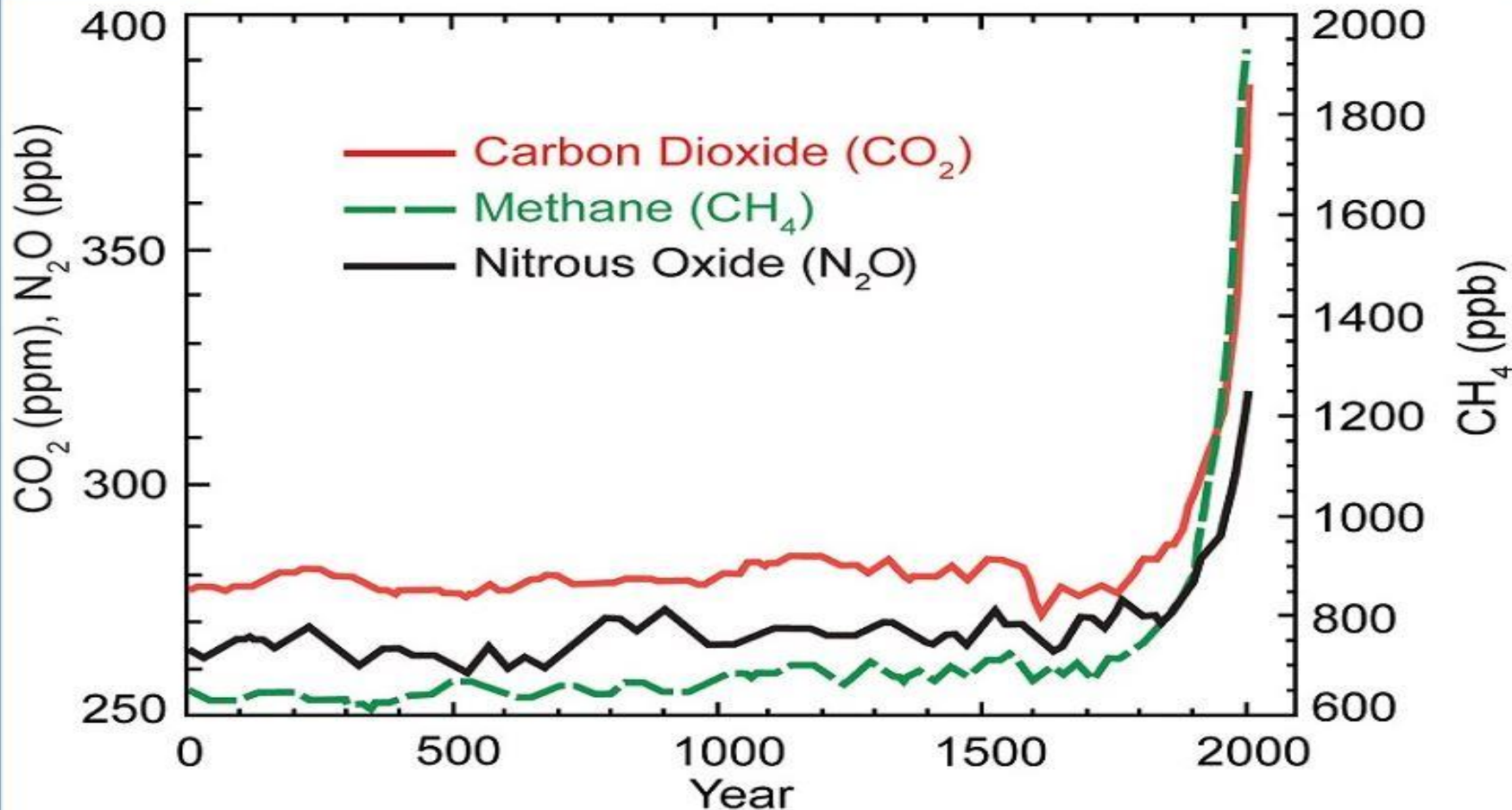


Population Growth as a Scapegoat

World Population vs. Global Anthropogenic CO2 Emissions



Atmospheric CO₂e



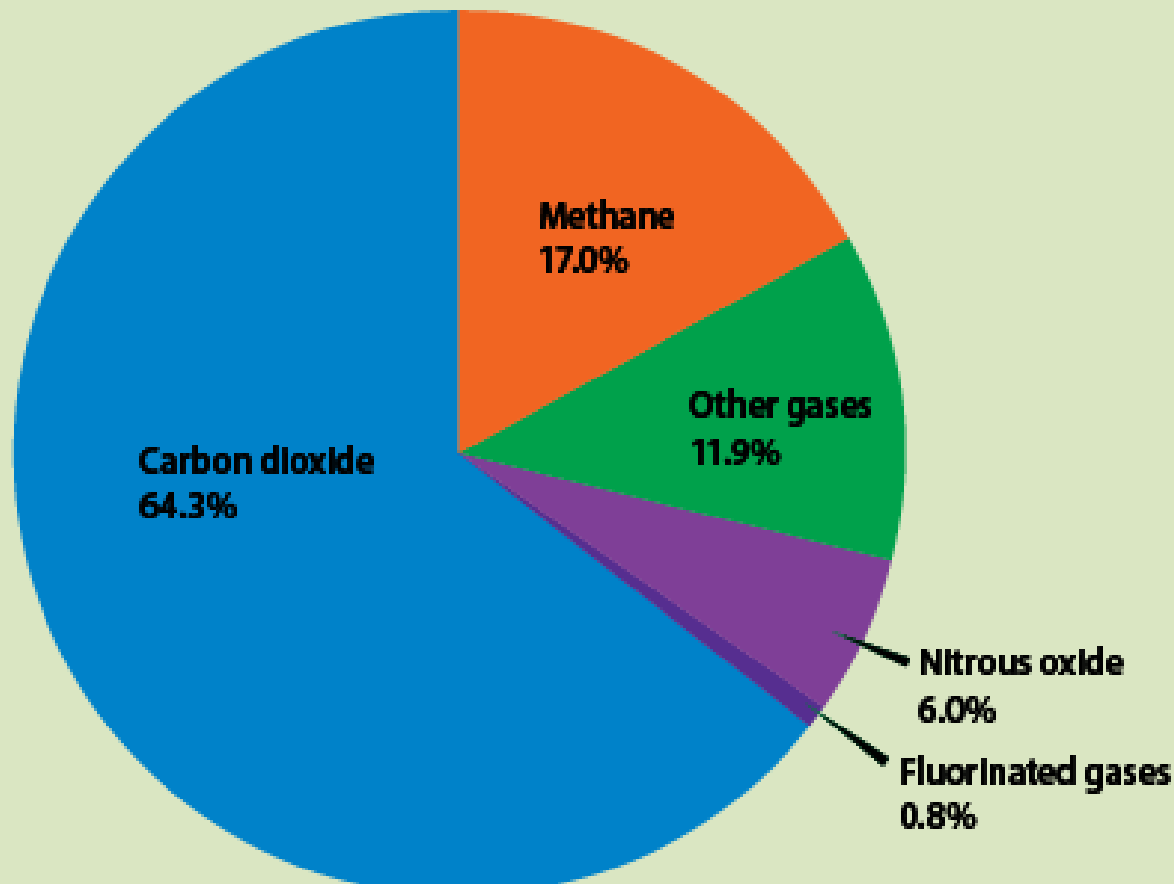
This graph shows the increase in greenhouse gas (GHG) concentrations in the atmosphere over the last 2,000 years. Increases in concentrations of these gases since 1750 are due to human activities in the industrial era. Concentration units are parts per million (ppm) or parts per billion (ppb), indicating the number of molecules of the greenhouse gas per million or billion molecules of air.

The Impact of CO₂e Gases

- **Carbon Dioxide CO₂** 1 GWP over a 100 year period
 - 84% of US GWP gases emitted by humans, complex global cycle
- **Methane CH₄** 21 GWP over a 100 year period
 - 9% of US GWP gases emitted by humans
 - Over 60% in atmosphere is emitted by human activities, globally
- **Nitrous Oxide N₂O** 310 GWP over a 100 year period
 - 5% of US GWP gases emitted by humans,
 - Over 40% in atmosphere is emitted by human activities, globally
- **Fluorinated Gases** 140-24,000 GWP over 100 year period
 - Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulfur Hexafluoride (SF₆)
 - 100% emitted by human activities

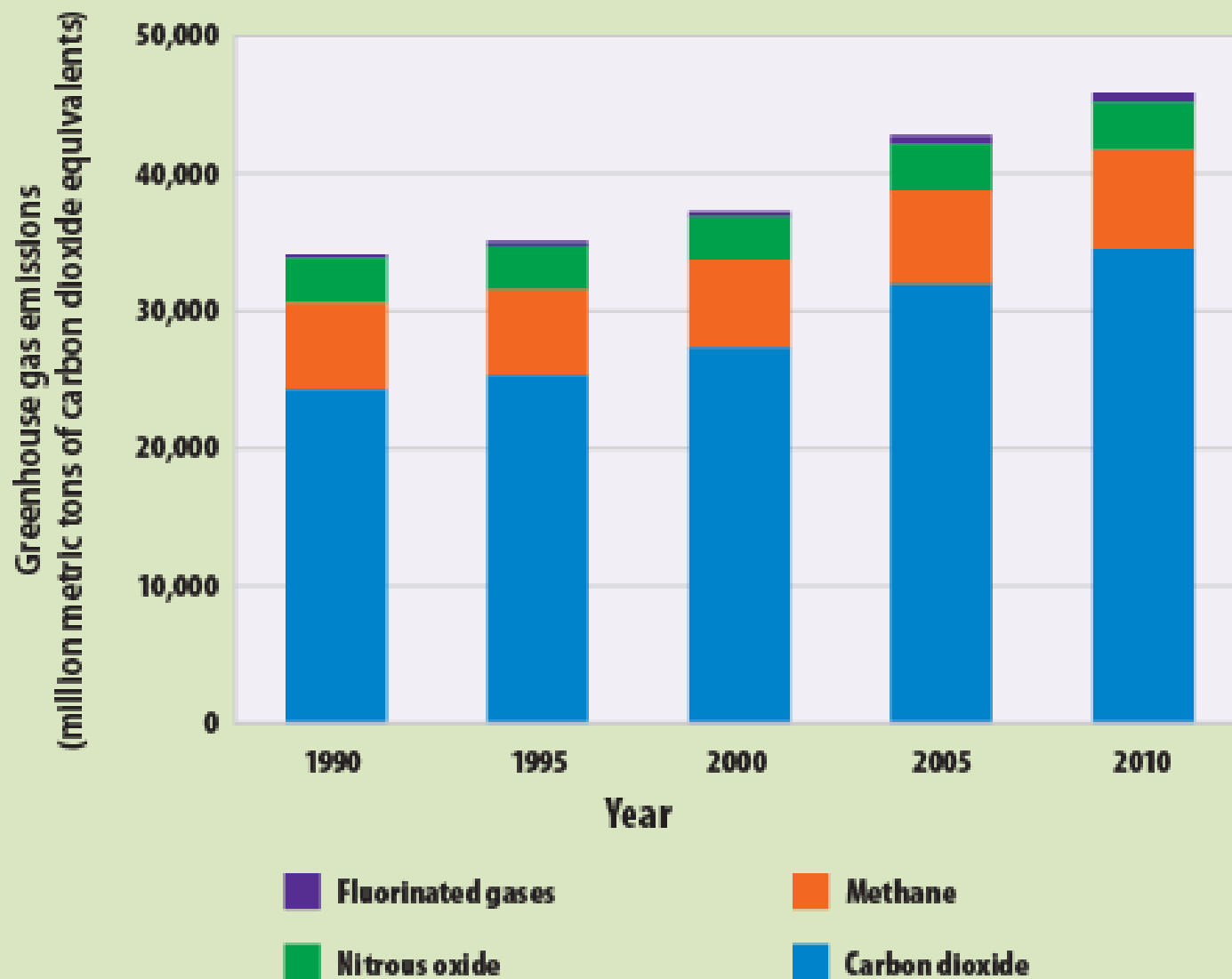
US - GWP Gas Emissions 2014

Major Greenhouse Gases from People's Activities



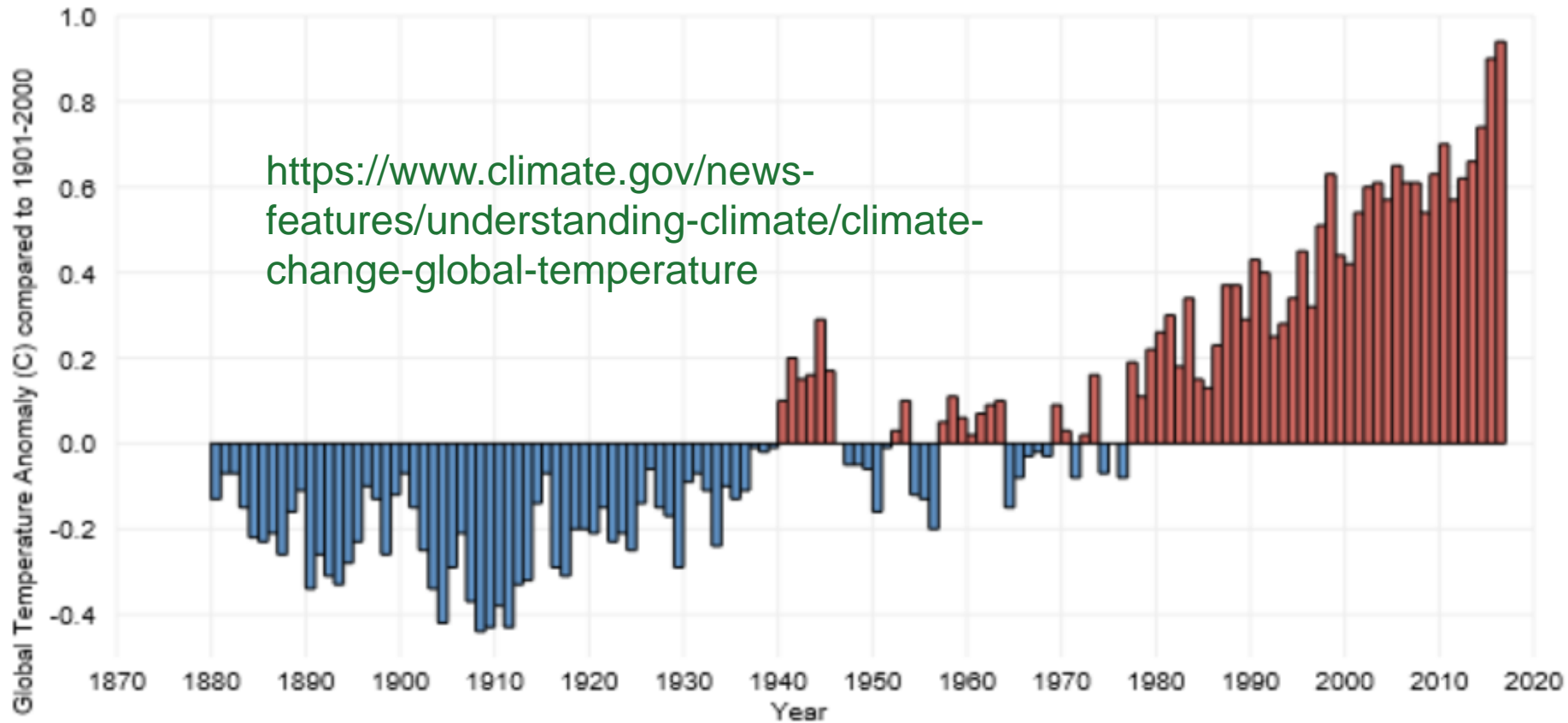
<https://archive.epa.gov/climatechange/kids/basics/today/greenhouse-gases.html>

Emissions of Greenhouse Gases Worldwide (1990–2010)



Reagan National Airport, Washington, D.C.

• July 6, 2012



Explore this interactive graph: Click and drag to display different parts of the graph. To squeeze or stretch the graph in either direction, hold your Shift key down, then click and drag. The graph shows average annual global temperatures since 1880 ([source data](#)) compared to the long-term average (1901-2000). The zero line represents the long-term average temperature for the whole planet; blue and red bars show the difference above or below average for each year.

<https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>

Farmingdale, Illinois

July 16, 2012

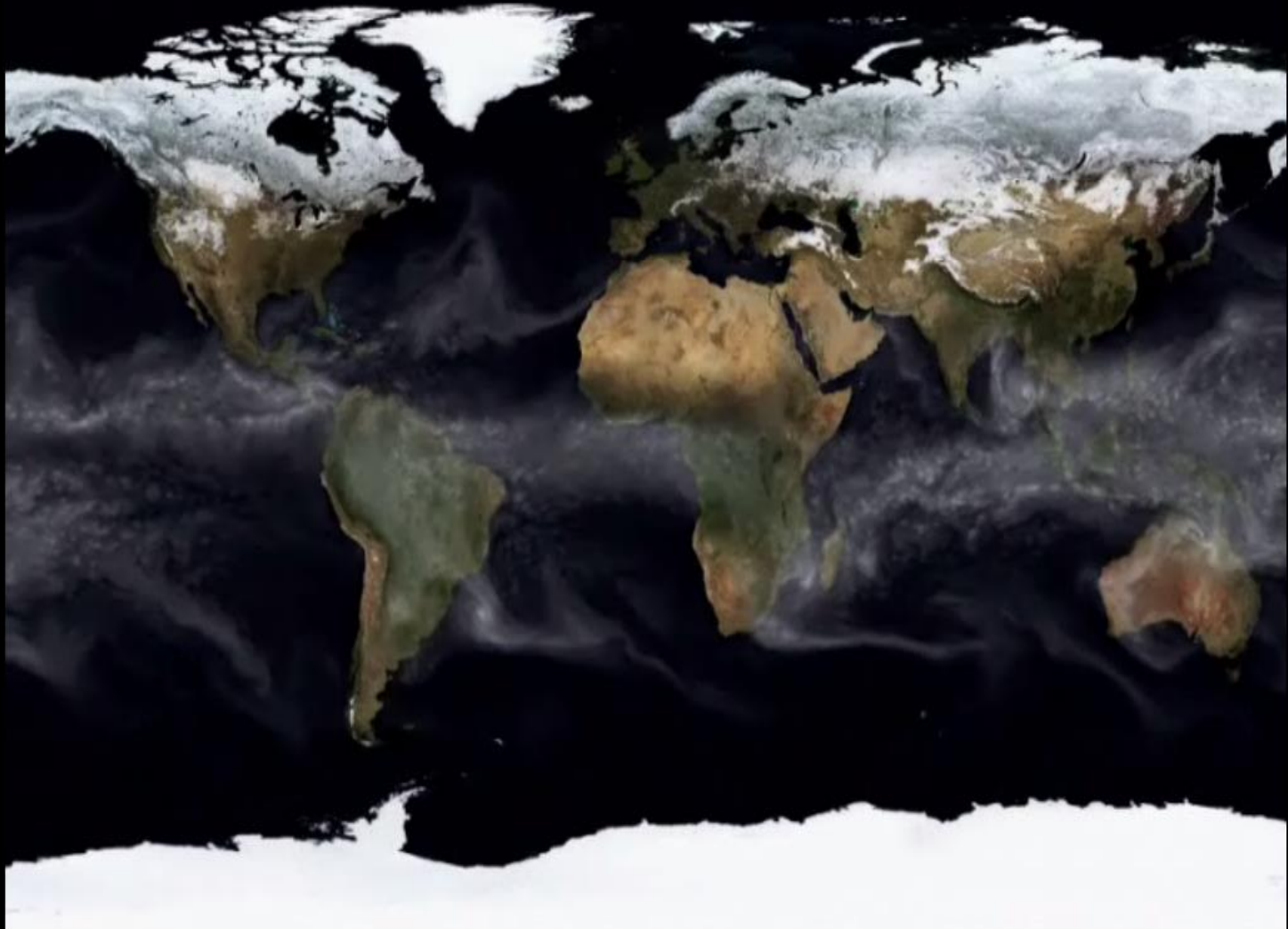
“It’s like farming in Hell.”

Fred Below

Plant biologist, University of Illinois in Urbana

July 2012

As temperatures increase, the oceans evaporate more moisture into the sky



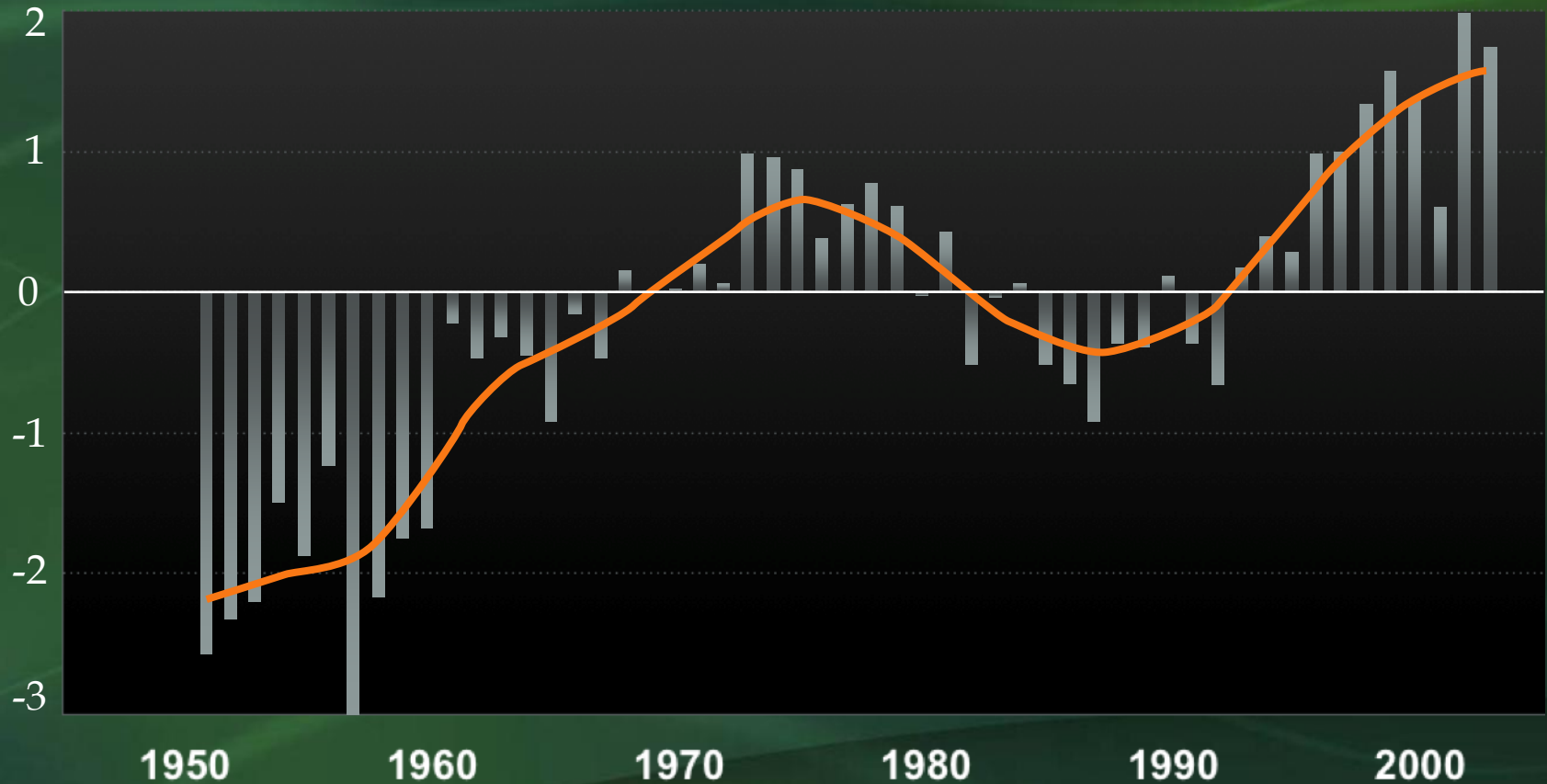
Montana

- July 28, 2010



Increase in Heavy Precipitation Days

Worldwide



Hurricane Sandy

● October 29, 2012



Atlantic City, New Jersey

■ October 29, 2012



Manhattan, New York

● October 29, 2012





The Rockaways, Queens, New York

October 30, 2012

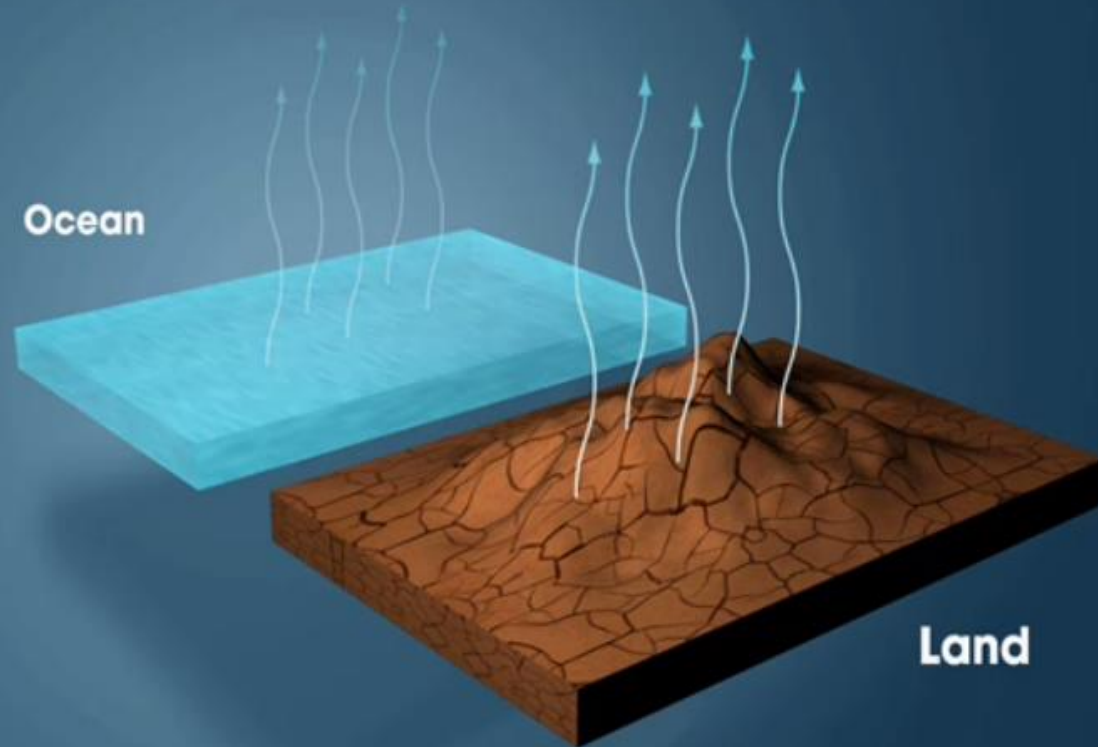


Recent Extreme Weather Events

A satellite image of a tropical storm or hurricane over the ocean. The storm is characterized by a distinct eye and a well-defined eye wall, surrounded by dense, swirling cloud bands. The surrounding ocean surface shows some wave patterns and a slight color gradient from blue to green.

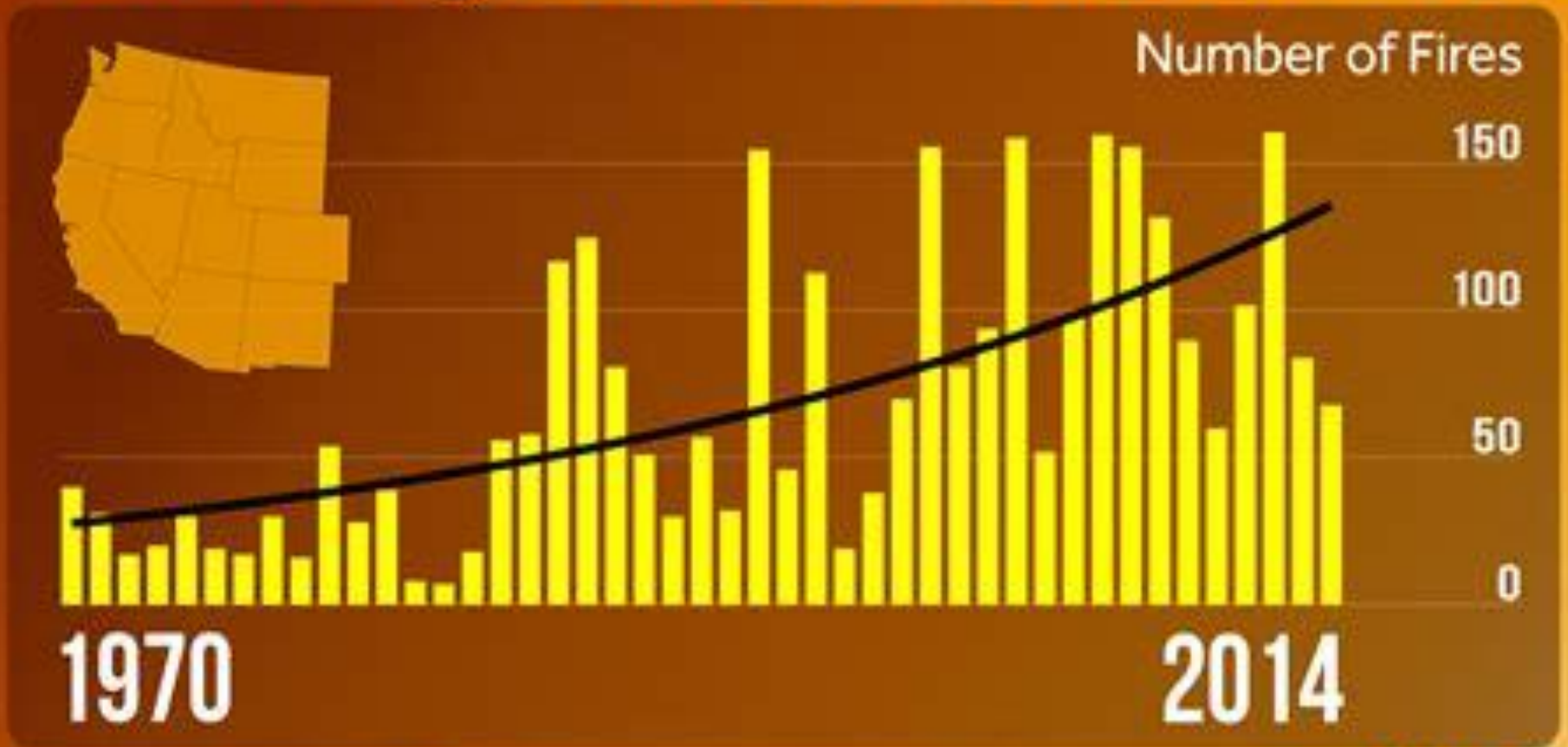
- Tropical Storm Irene
August 2011
- Tropical Storm Lee
September 2011
- Hurricane Sandy
October 2012
- **THREE** Nor'easters in
March 2018

The same extra heat that evaporates water from the ocean pulls moisture even more quickly from the soil





More Large Wildfires in the West



Source: Climate Central, Large Fires Greater Than 1,000 Acres

West Fork Complex Fire, Colorado

- June 20, 2013

What Has Happened So Far:

- CO₂ at 310 ppm, compared to historical 270
- 1.8 degree F rise in temperatures since 1880
- 7-inch rise in sea level over past 100 years
- Increase in severe drought events
- Increase in severe rain events
- Decrease in Arctic ice thickness

What Will Happen in the Future:

- Further increase in temperatures, further rise in sea levels, more climate instability
- Further increase in sea levels
- Increase in societal stresses

What May – or May Not - Happen:

- Sea level rise of several feet
- Destabilization of oceanic balances
- Cessation of ocean currents
- Severe climate destabilization, especially northern Europe
- Widespread extinctions
- Severe societal stresses

2. Cultural Perspectives

Climate Scientists and ACC

“97 – 98% of the climate researchers most actively publishing in the field support the tenets of ACC (anthropogenic climate change) outlined by the IPCC.”

Anderegg, et al.,

Proceedings of the National Academy of Sciences

June 21, 2010

Jim – tell them the analogy of the doctor!

Every National Academy of Science of Every Major Country in the World Confirms Anthropogenic Global Warming

African Academy
of Science
Australia
Belgium
Brazil
Cameroon
Canada
The Caribbean
China
France
Ghana
Germany

Indonesia
Ireland
Italy
India
Japan
Kenya
Madagascar
Malaysia
Mexico
Nigeria
New Zealand
Russia

Senegal
South Africa
Sudan
Sweden
Tanzania
Turkey
Uganda
United Kingdom
United States
Zambia
Zimbabwe

National Academies *Rejecting* the Science of Anthropogenic Global Warming

None

Every Major Scientific Society in the World in Fields Related to the Study of Global Warming Confirms the Consensus

American Academy of Pediatrics

American Association for the Advancement of Science

American Association of Wildlife Veterinarians

American Chemical Society

American College of Preventive Medicine

American Geophysical Union

American Medical Association

American Meteorological Society

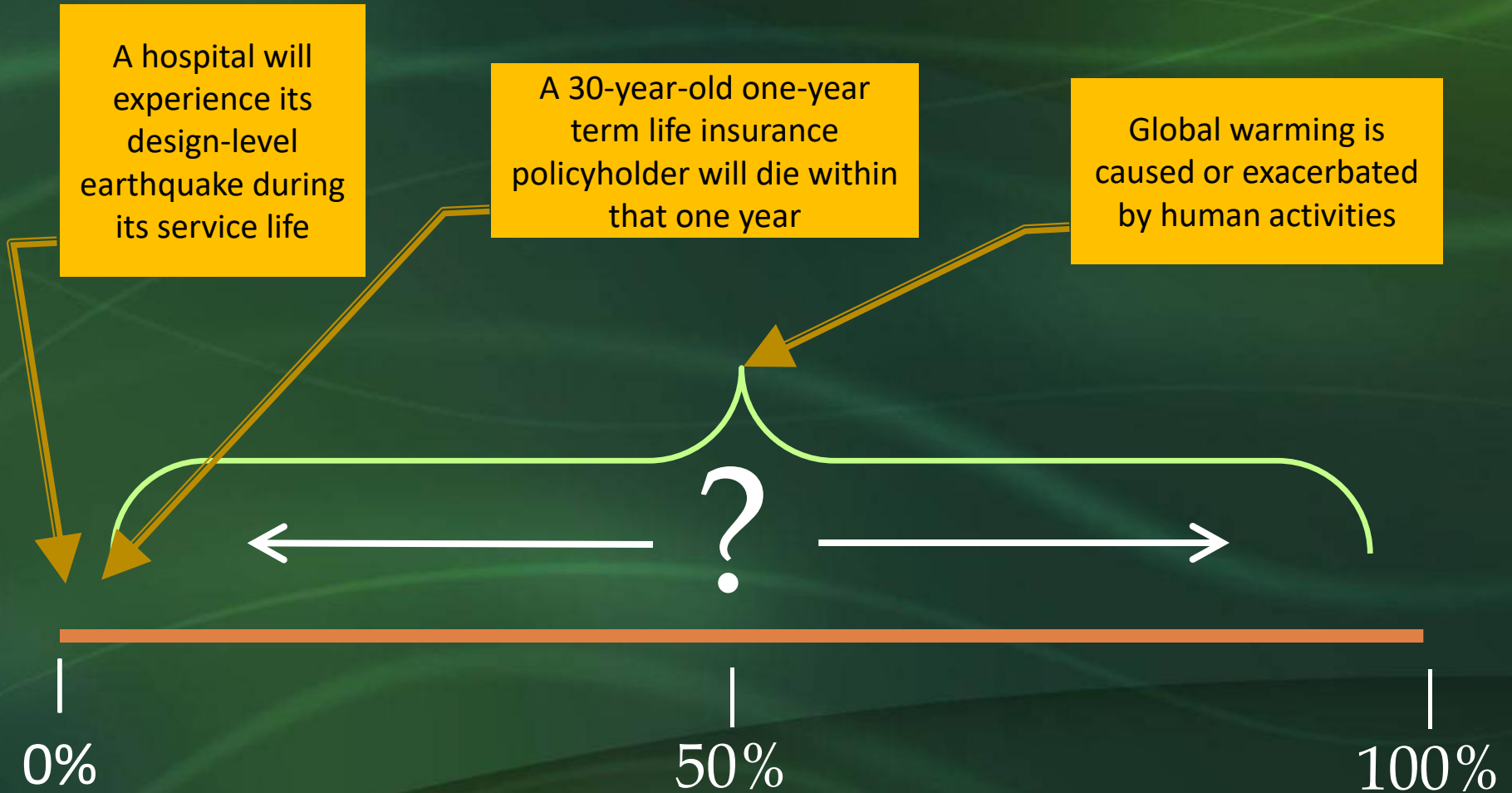
American Public Health Association

American Physical Society

American Quaternary Association

American Society for Microbiology

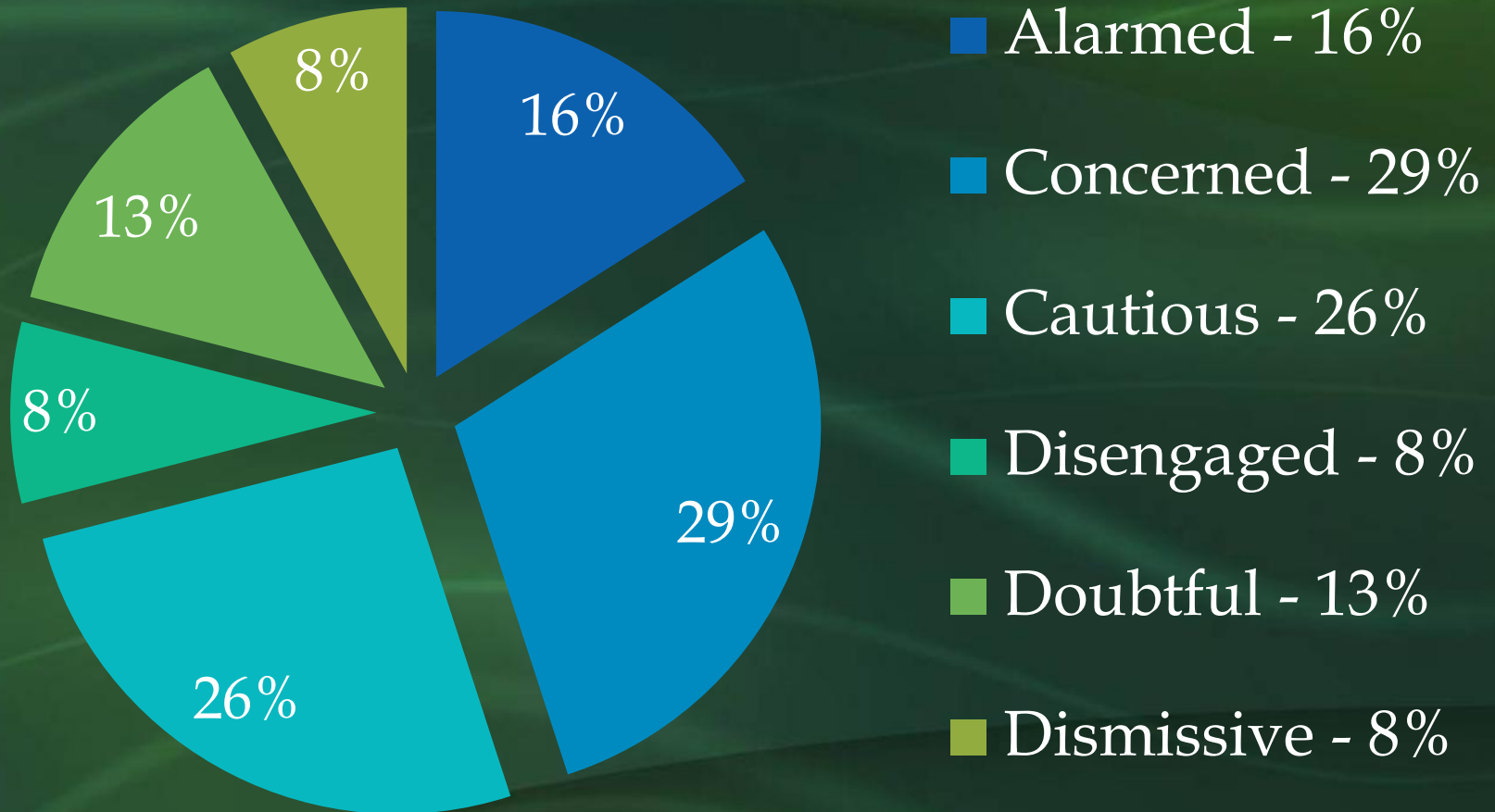
How likely is the hypothesis true?



...and at what point do we take action?

Six Different Americas

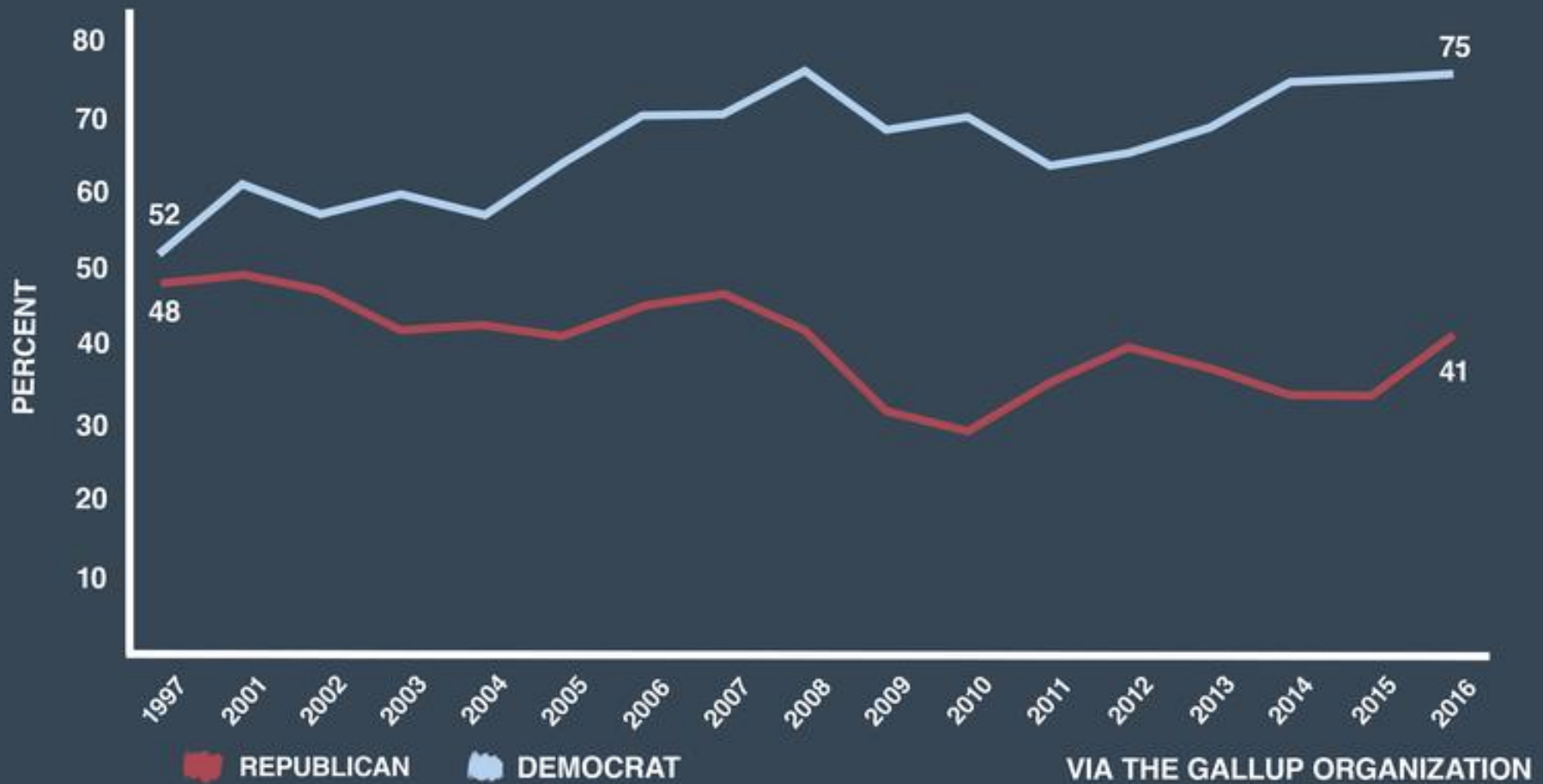
regarding climate change opinions



Source: Anthony Leiserowitz - Director of the [Yale Project on Climate Change Communication](#) and a Research Scientist at the School of Forestry and Environmental Studies at Yale University

Changing Politics of Climate Change

HAVE THE EFFECTS OF GLOBAL WARMING ALREADY BEGUN?



Where are YOU on Climate Change?

Climate change is a serious problem and we need to do all that we can right now – politically, professionally, and personally.

Climate change is a serious problem but...

... we're moving in the right direction – no need to take drastic action. There's time.

... the problem is oil & gas companies / overpopulation / China / our government / the other party / etc.

Climate change may be a problem, but...

... government programs aren't the answer.

... a solution will present itself in time.

... it's too late to stop it.

... I don't even want to think about it.

... we can't risk damage to our institutions.

The earth is not getting warmer.

Climate change may be happening, but it's not caused by humans.

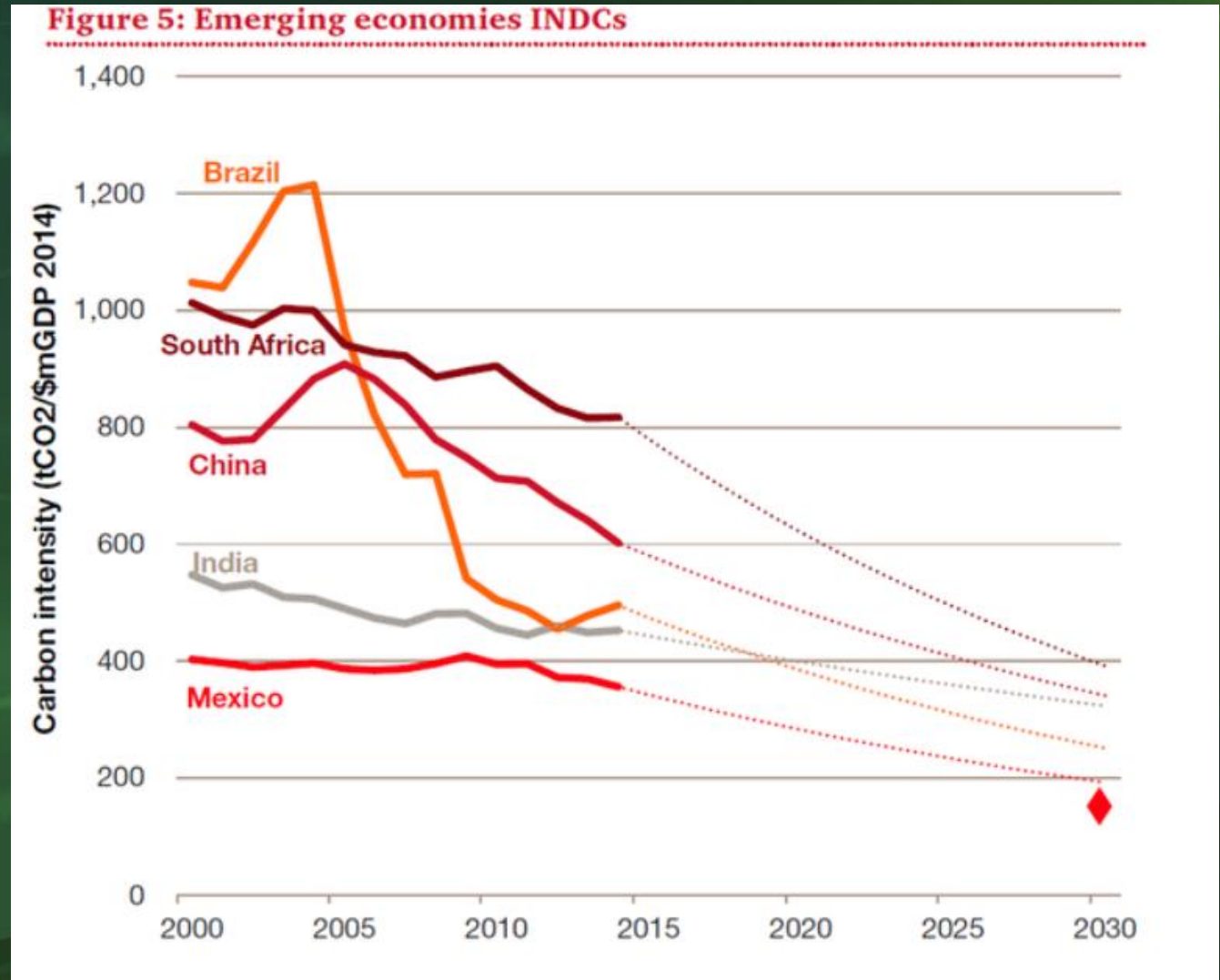
Climate change isn't a bad thing, so not to worry.

I don't know – I've heard lots of different opinions.

3. **Current Trends and Market Shifts**

Current Trends and Market Shifts

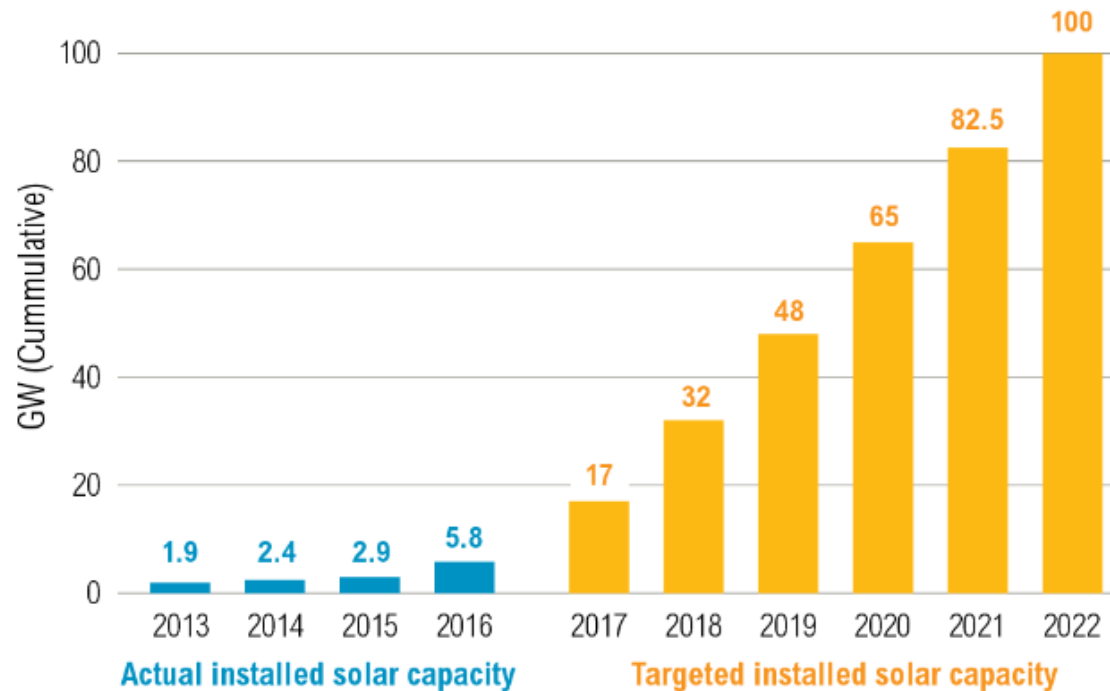
Emerging Economies



Current Trends and Market Shifts

India

India Sets Year-on-Year Targets to Reach Ambitious 2022 Solar Goal



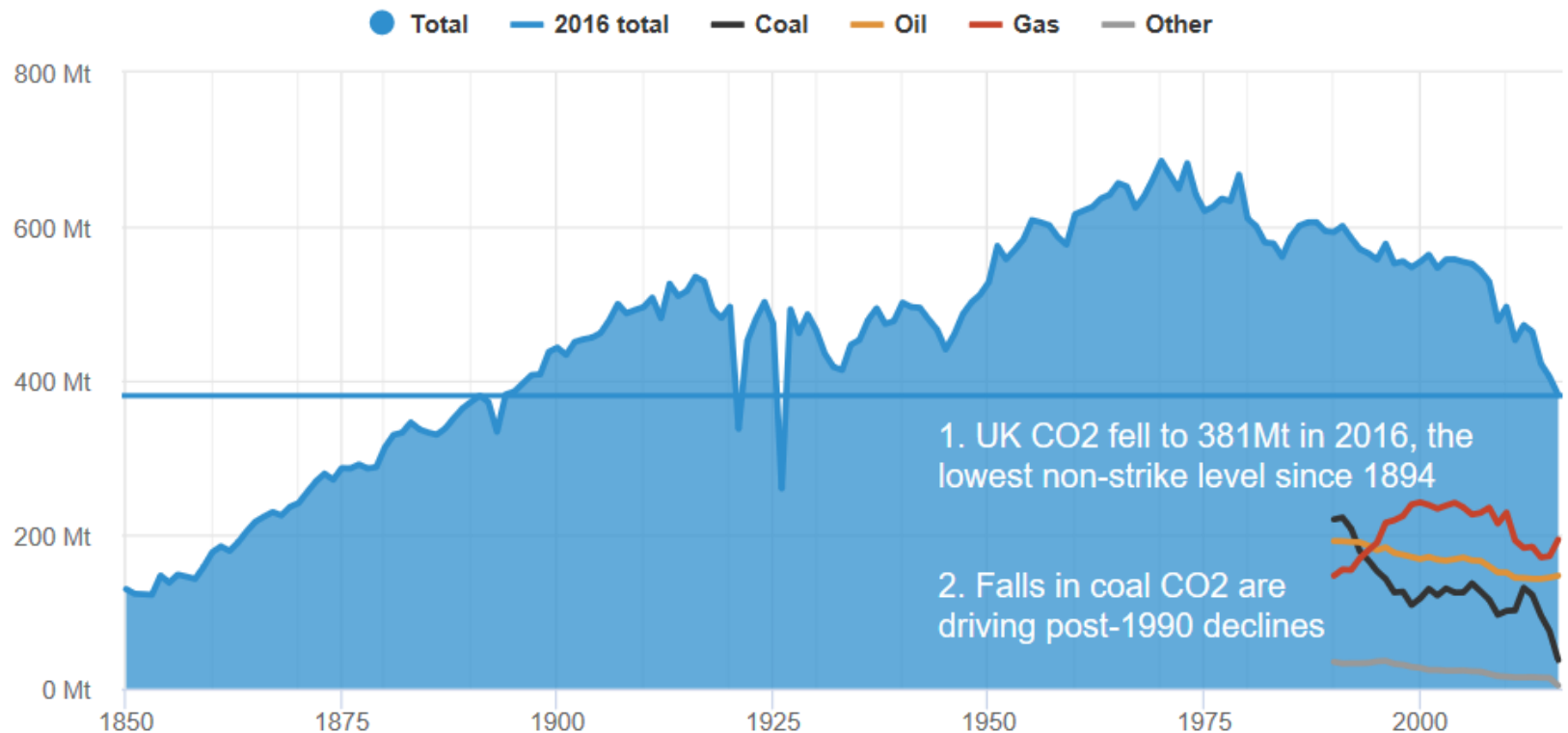
Notes: FY = All years in chart are fiscal year from April 1 to March 31; 1 GW = 1,000 MW.

Sources: Bloomberg New Energy Finance (BNEF); The Economic Times.

Current Trends and Market Shifts

UK: CO2 emissions fell by 5.8% in 2016, down 36% below 1990 levels. Focus: **Coal**

UK CO2 emissions 1850-2016



Current Trends and Market Shifts



WORLD RESOURCES INSTITUTE

COP21 MAJOR OUTCOMES

5 Key Elements of the Paris Agreement

Every 5
years countries
**STRENGTHEN
CLIMATE
ACTIONS**

ADAPTATION
is a central pillar
to help world's
most vulnerable

**LONG-TERM
GOAL**
to achieve net
zero emissions

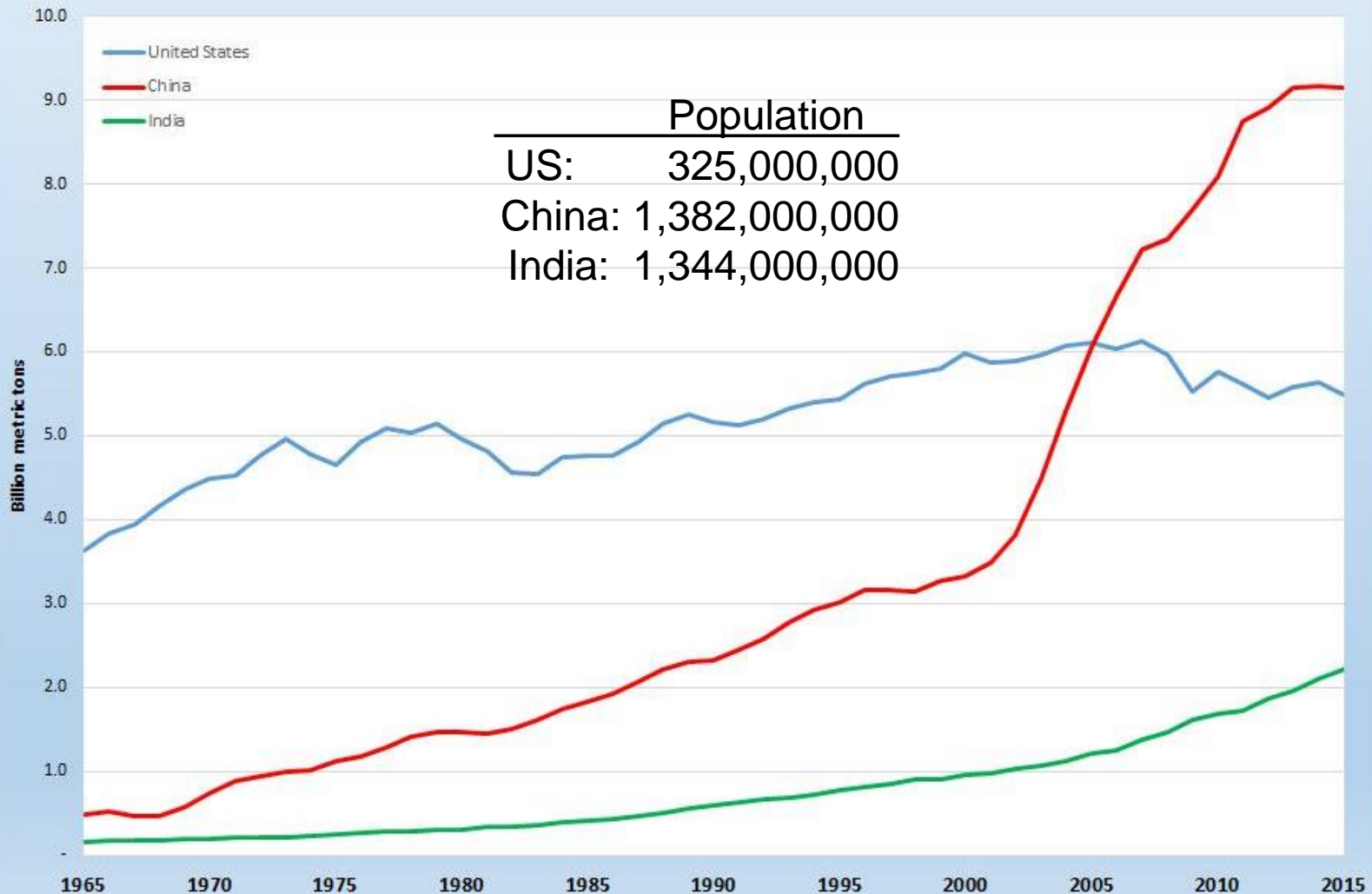
**ENHANCED
TRANSPARENCY**
to ensure
commitments
are met

**CLIMATE
FINANCE**
to support
developing
countries

10,000 New Climate Initiatives

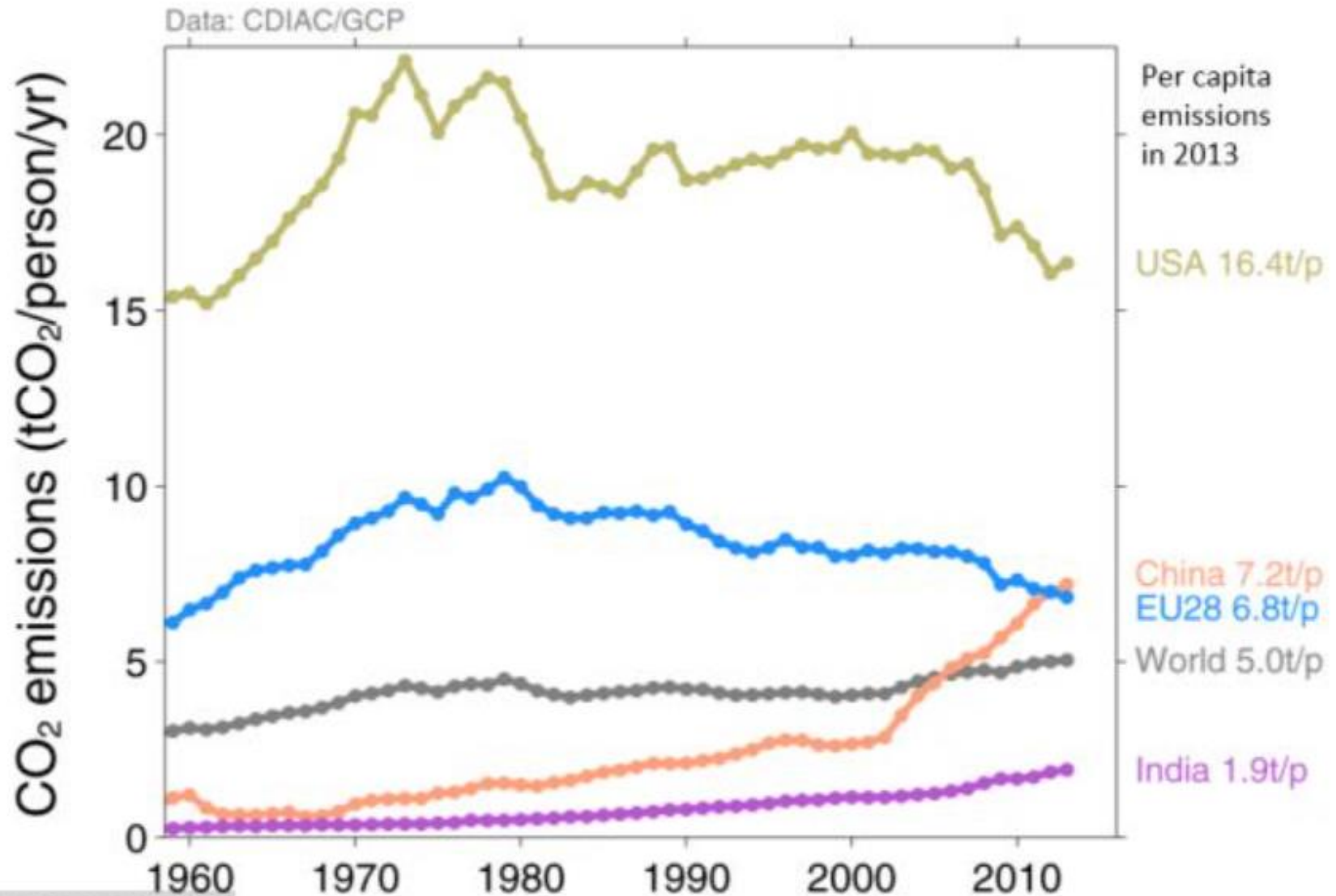
Current Trends and Market Shifts

Carbon Dioxide Emissions 1965-2015



Population	
US:	325,000,000
China:	1,382,000,000
India:	1,344,000,000

Current Trends and Market Shifts



Current Trends and Market Shifts

Paris COP21

https://www.connect4climate.org/sites/default/files/images/ifg/COP21_wrapup-WRI.jpg



Current Trends and Market Shifts: US Businesses and Paris COP21

April 26, 2017

The Honorable Donald J. Trump
President of the United States
The White House
1600 Pennsylvania Avenue, NW
Washington, D.C.

Dear Mr. President,

We write to express our support for continued participation by the United States in the Paris climate change agreement.

Climate change
U.S. business in
effective and ba
framework.

Companies base
agreement in ma

- **Strengt**
developi
reducing
- **Support**
improvi
enabling

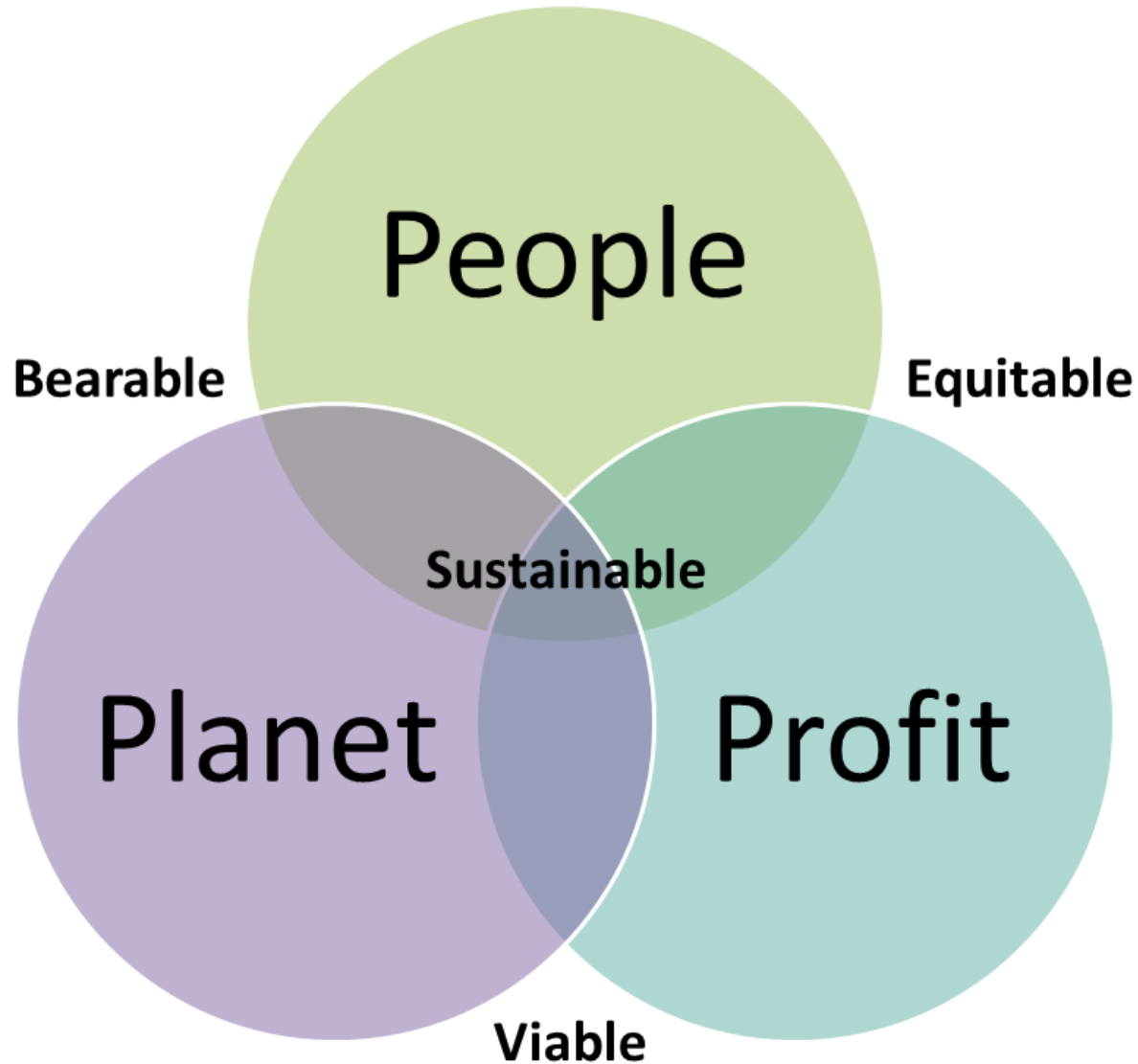
Sincerely,

Apple
BHP Billiton
BP
DuPont
General Mills
Google
Intel
Microsoft

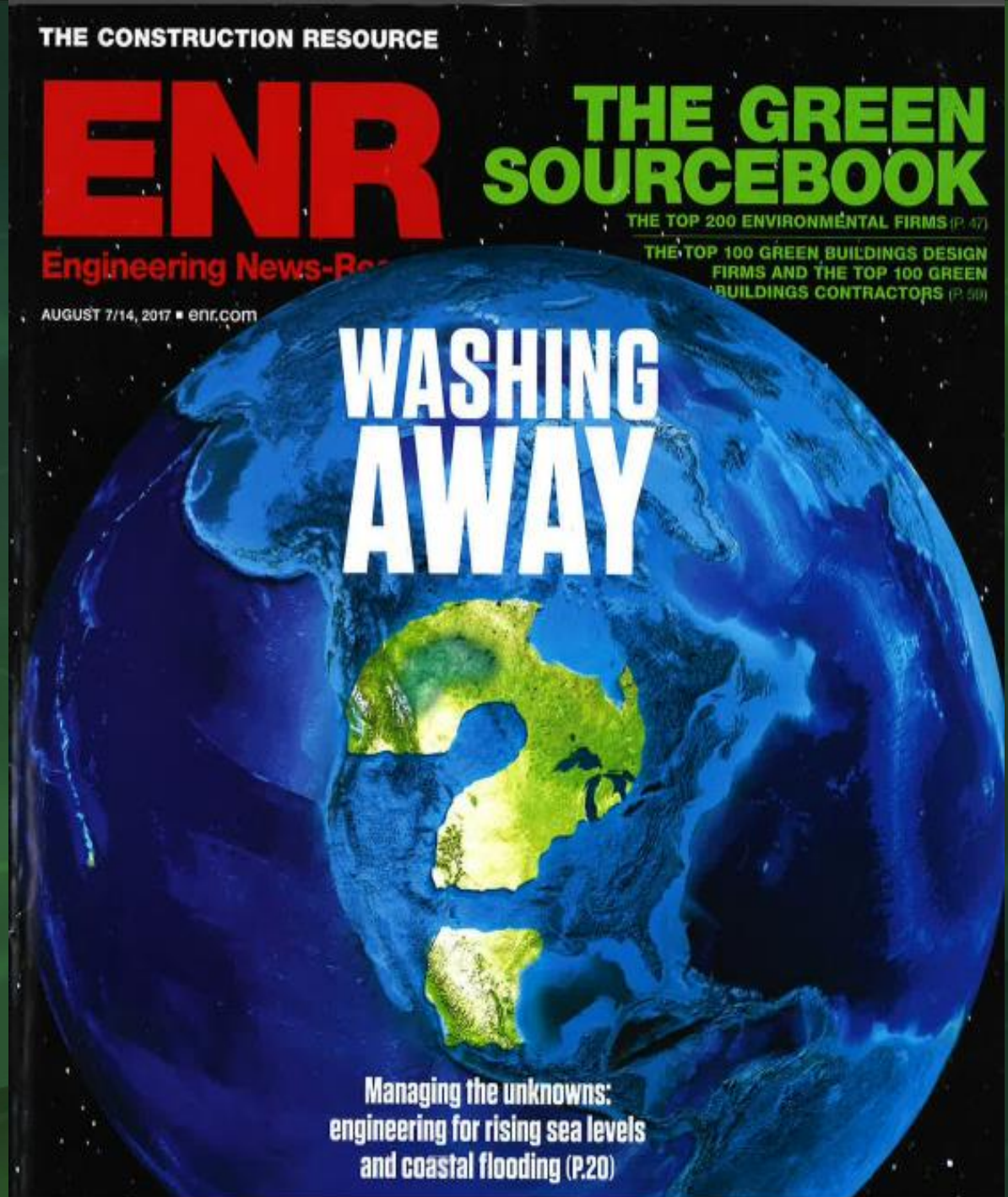
National Grid
Novartis Corporation
PG&E
Rio Tinto
Schneider Electric
Shell
Unilever
Walmart

better long-term planning and investment.

The Triple Bottom Line



Current Trends and Market Shifts



Current Trends and Market Shifts

News

ENERGY

RGGI Proposes Ambitious New Carbon Targets for 2030

Proposed stringent emission-reduction targets through 2030 in the nation's only interstate cap-and-trade program will continue the already well-established market shift toward renewable and efficient power-generation construction projects, industry analysts say.



ON POINT Offshore wind farms, like this one off Rhode Island, could help states to hit new RGGI targets.

The Regional Greenhouse Gas Initiative (RGGI), which spans nine Northeast and mid-Atlantic states, on Aug. 23 said it has agreed to set lower emissions caps by an additional 30% in 2030 over reductions achieved by 2020.

The more ambitious reduction targets likely will continue the trend toward more renewable-energy projects in the Northeast, along with gas-fired generation projects. But "it's really the market forces,"

federal leadership and market momentum shows us that the parties ... are going to continue to address this.

Byers concurs. "It's a good example of how the market works long before the federal leadership."

MATERIALS

Wood Connectors Pass Fire Tests

Successful performance in fire tests of three types of off-the-shelf metal connectors for glue-laminated-timber column-to-beam assemblies will make it easier for designers to get approval for GLT structural systems in buildings up to 85 ft in height, says the Softwood Lumber Board, which sponsored the tests.

With the test report as documentation, designers now should be able to specify the tested assemblies and satisfy requirements of the International Building Code for mass-timber buildings, which the IBC refers to as Type II construction, says the group.

10

ENERGY/ENVIRONMENT/SUSTAINABILITY/MANUFACTURING

BUSINESS JOURNAL NEWS NETWORK | SEPTEMBER 10, 2017

BY ERIC

New York, RGGI states seek to cut emissions another 30 percent by 2030

RGGI Inc.

BY ERIC REINHARDT
erh@earthlink.net

New York is among nine states proposing to reduce the cap on power-plant emissions an additional 30 percent below 2020 levels by 2030.

The states involved are part of the Regional Greenhouse Gas Initiative (RGGI) and their effort seeks to lower CO2 emissions, the office of Gov. Andrew Cuomo announced in a news release issued Aug. 23.

In "telling" Cuomo's State of the State challenge to the RGGI states to "further strengthen" the RGGI program, which the

RGGI contributed to a nearly 50 percent reduction in carbon-dioxide emissions from affected power plants in New York, and a 90 percent reduction in coal-fired power generation in the state, Cuomo's release stated.

To date, New York says it has generated more than \$4 billion in RGGI proceeds, which help fund energy-efficiency, clean energy, and emissions-reduction programs.

Cuomo in 2013 led the RGGI states in reducing the emissions cap 50 percent by 2020. RGGI "continues to exceed expectations" and has provided more than \$2 billion in regional economic benefits and \$5.7 billion in job-to-be-held benefits, he said.

York State Department of Environmental Conservation, said in the news release.

Support for the program

In a statement released Aug. 23, Conor Barrick, air & energy director at Environmental Advocates of New York, said the organization applauds the RGGI proposal.

"New York and RGGI states are demonstrating that climate leadership is not simply maintaining the status quo ... it can't be when the U.S. is jailing out of the Paris Agreement, and the Environmental Protection Agency is taking no action."

state government, evaluates proposed laws, and supports policies and practices that will "ensure the responsible stewardship of our shared environment."

Criticism of the program

Critics of RGGI say it has not produced the emissions reductions and health benefits that its advocates say it has, while increasing energy costs and costing jobs.

A Cato Institute paper by David Stebbins (<https://www.cato.org/publications/working-paper/review-regional-green-gas-initiative>) issued Aug. 10 made the following conclusion:

Current Trends and Market Shifts

PE REPORT

Summit Brings Global Attention to 'Grand Challenges'

Engineering leaders from the US, the United Kingdom, and China met in Washington, DC, in July to draw attention to the world's biggest engineering challenges and inspire solutions.

Climate change, women in engineering, and new advances in virtual reality technology were all hot topics at this year's Global Grand Challenges Summit. The event hosted engineers, policy makers, and students, who came together July 18–20 to tackle some of the toughest global challenges. The summit was the third time the National Academy of Engineering, the UK Royal Academy of Engineering, and the Chinese Academy of Engineering met to brainstorm and collaborate.

"The goal of this 2017 summit is to inspire the next generation of engineers, policy makers, and the public to address critically important engineering challenges and opportunities facing humanity. It will take more than just this generation to address these challenges," said National Academy of Engineering Chair Gordon England.



STUDENTS FROM AROUND THE WORLD TRIED OUT THE LATEST VIRTUAL REALITY TECHNOLOGY AT THE 2017 GLOBAL GRAND CHALLENGES SUMMIT IN WASHINGTON, DC.

The summit included speakers from around the world, a brainstorming session for participants, technology trials, and the inaugural FIRST Global Challenge, an international robotics competition. This was the first summit to coincide with the annual competition, which will address one of the grand challenges each year. At this year's competition, participants collaborated to

to the world's biggest engineering challenges and inspire solutions.

Climate change, women in engineering, and new advances in virtual reality technology were all hot topics at this year's Global Grand Challenges Summit. The event hosted engineers, policy makers, and students, who came together July 18–20

Current Trends and Market Shifts

News

CARBON CAPTURE

New CCS Technology Could Be Game Changer for Fossil Fuels



VALIDATING A new technology being tested in Texas uses captured CO₂ gas to power turbines.

A new demonstration power plant | cally for the process. The Allam Cycle

group that evaluates different electric power technologies, says most utilities are taking a wait-and-see approach to the technology. "It looks good on paper ... the system has efficiencies that look like a natural gas combined cycle without CO₂ capture." Still, testing and validation is a necessary step, he says.

Allen says Net Power will be most economical with a 300-MW plant. Once the plant is validated, Net Power will begin looking for a client for the first commercial-scale plant, he says.

Changing the Equation

With a few exceptions, CCS has failed to take off in the power sector. Existing CCS technologies make plants more expensive to operate, which has prevented CCS from becoming widespread in the power sector, Herzog says. Because Net Power emits no CO₂ and actually produces some for sale for enhanced oil recovery, the costs come down, he explains.

Despite the missteps, CCS projects

Current Trends and Market Shifts

CLIMATE CHANGE

Cities, States Lead Efforts To Cut Carbon Emissions



STATE EFFORTS Adoption of energy-efficient building codes varies throughout the country.

Still, overall, the IECC has cut CO₂ emissions by 36 million metric tons and cut costs by \$44 billion over its 20-year existence, according to the Energy Dept. The code is expected to reduce CO₂ emissions by 841 million metric tons from 2010 through 2040.

So far, the only jurisdiction that has adopted the 2018 code update is the U.S. Virgin Islands.

Cities may choose to stick with the earlier versions of the code. Zach Baumer, climate program manager for Austin, Texas, says the city uses the 2015 IECC with amendments that make it tougher. "I think a lot of the focus has been on the new code because we have so many new buildings, there's so much growth and construction happening in our city," he says.

But cities are using other tools as well to tackle emissions, with a focus on buildings. "If you break down the way we look at reducing carbon emissions, we're going to look at the biggest chunk first, and about 70-72% of our emissions come from buildings," says Sandra Henry, Chicago's chief sustainability officer.

Next year, Chicago will expand on a 2014 benchmarking ordinance with a ratings system for buildings. Each building



Nursery Stock and Seed Wholesale Availability List

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March 2018

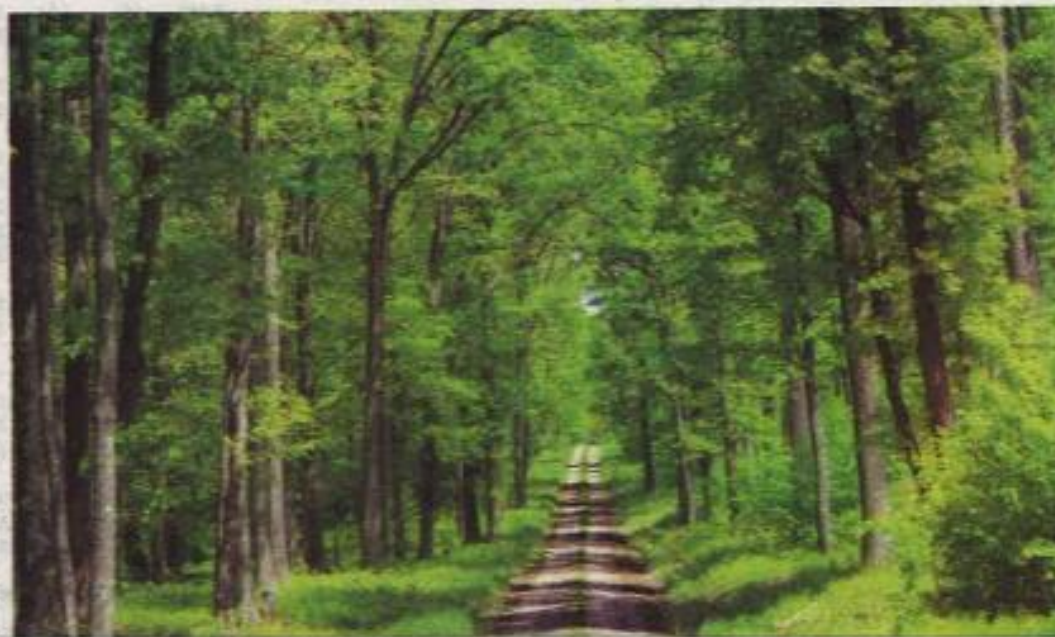
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Tired of Hearing About Climate Change, Trees Move North and West

Unpredictable weather events, drought, longer growing seasons, warmer daily temperatures, all these make growing trees a challenge. Increased temperatures have resulted in widespread droughts as measured by the Palmer Drought Severity Index. Since 1980, the northeast has experienced a little more rain than it did during the preceding century but the southeast has gotten much less rain. The Great Plains has gotten much more than was normal historically. A recent study focusing on the eastern U.S. may help with some answers about the range expansion for many tree species.

Inventory and Analysis Program, covering 86 tree species, Dr. Songlin Fei, Purdue University professor and his research team found that trees had divergent responses to the weather changes. Long term high quality data sets and sound analysis lead to definitive results.

It has been thought that with increased temperatures, tree species would expand their ranges by occurring at higher elevations as well as moving north toward the pole but Songlin found that



4. Carbon Pricing – Costs vs. Benefits



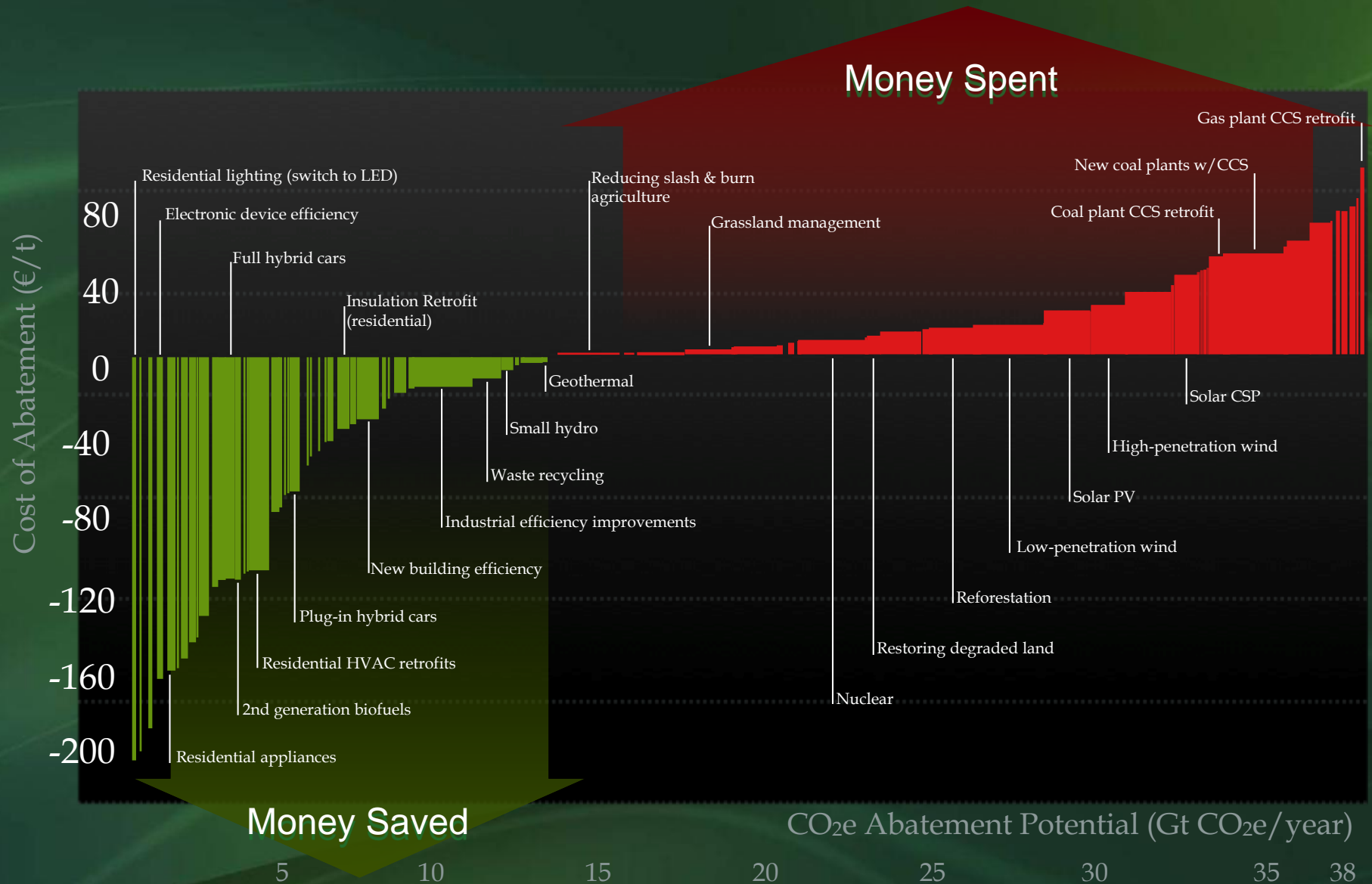
CLIMATE SUMMIT

WHAT IF IT'S
A BIG HOAX AND
WE CREATE A BETTER
WORLD FOR NOTHING?

- ENERGY INDEPENDENCE
- PRESERVE RAINFORESTS
- SUSTAINABILITY
- GREEN JOBS
- LIVABLE CITIES
- RENEWABLES
- CLEAN WATER, AIR
- HEALTHY CHILDREN
- ETC. ETC.



The Cost of Reducing Greenhouse Gases



Energy Innovation and Carbon Dividend Act – H.R. 763



- EFFECTIVE – will reduce CO₂ emissions by 40% in first 12 years
- GOOD FOR PEOPLE – increased health, more \$ for lower income
- GOOD FOR THE ECONOMY – 2.1 million new jobs, increased GDP
- BIPARTISAN – Cosponsored by Republicans and Democrats
- REVENUE NEUTRAL – No \$ kept or spent by the government

<https://citizensclimatelobby.org/energy-innovation-and-carbon-dividend-act/>

Citizens' Climate Lobby

- Volunteer lobbyists advocating CO₂ reduction
- Carbon Fee and Dividend
 - Places a steadily rising fee on the CO₂ content of fossil fuels.
 - Gives all of the revenue from the carbon fee back to households.
 - Border adjustments will discourage businesses from relocating.
 - It's good for the economy AND even better for the climate

www.citizensclimatelobby.org

Benefits to Carbon Reduction: Health, Productivity and Well-Being



THE ECONOMIC, CLIMATE, FISCAL, POWER, AND DEMOGRAPHIC IMPACT OF A NATIONAL FEE-AND- DIVIDEND CARBON TAX

Benefits to Carbon Reduction: Health, Productivity and Well-Being

The Environmental, Economic and Health Impact of Carbon Fee and Dividend

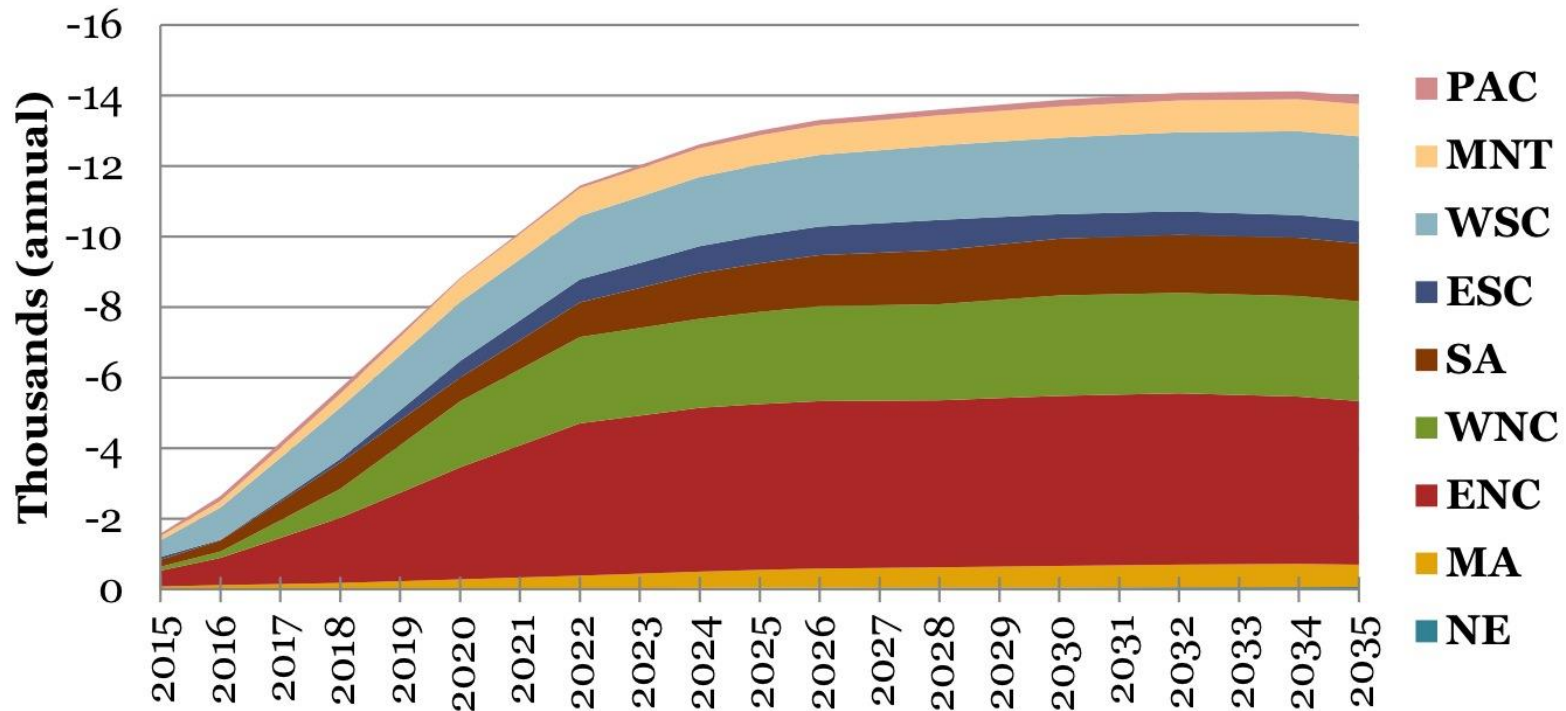
In 2013, CCE commissioned Regional Economic Models, Inc. (REMI) to study [the effect of a revenue-neutral carbon price on the American economy](#). Chosen for its track record of providing analysis to both governmental bodies and the fossil fuel corporations, REMI's analysis concluded that such a system would have strong positive economic effects on the nation's health and prosperity alike.

REMI's analysis concluded that, during the first 20 years alone, a CF&D policy would lead to:

- A 50% reduction of carbon emissions below 1990 levels
- The addition of 2.8 million jobs above baseline, driven by the steady economic stimulus of the energy dividend
- The avoidance of 230,000 premature deaths due to reduction in air pollutants that often accompany carbon emissions

Benefits to Carbon Reduction: Health, Productivity and Well-Being

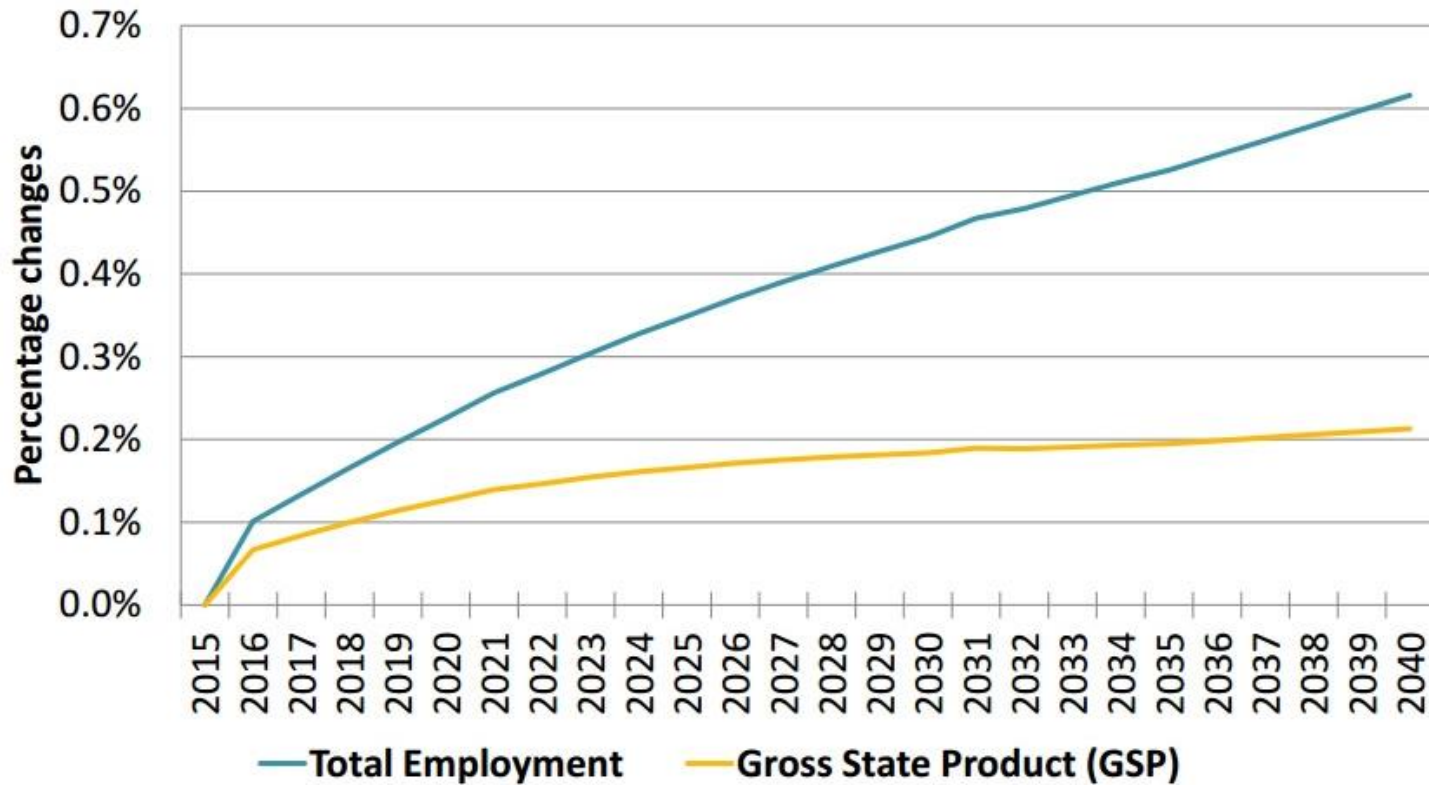
Saved Premature Deaths (annual, regional level)



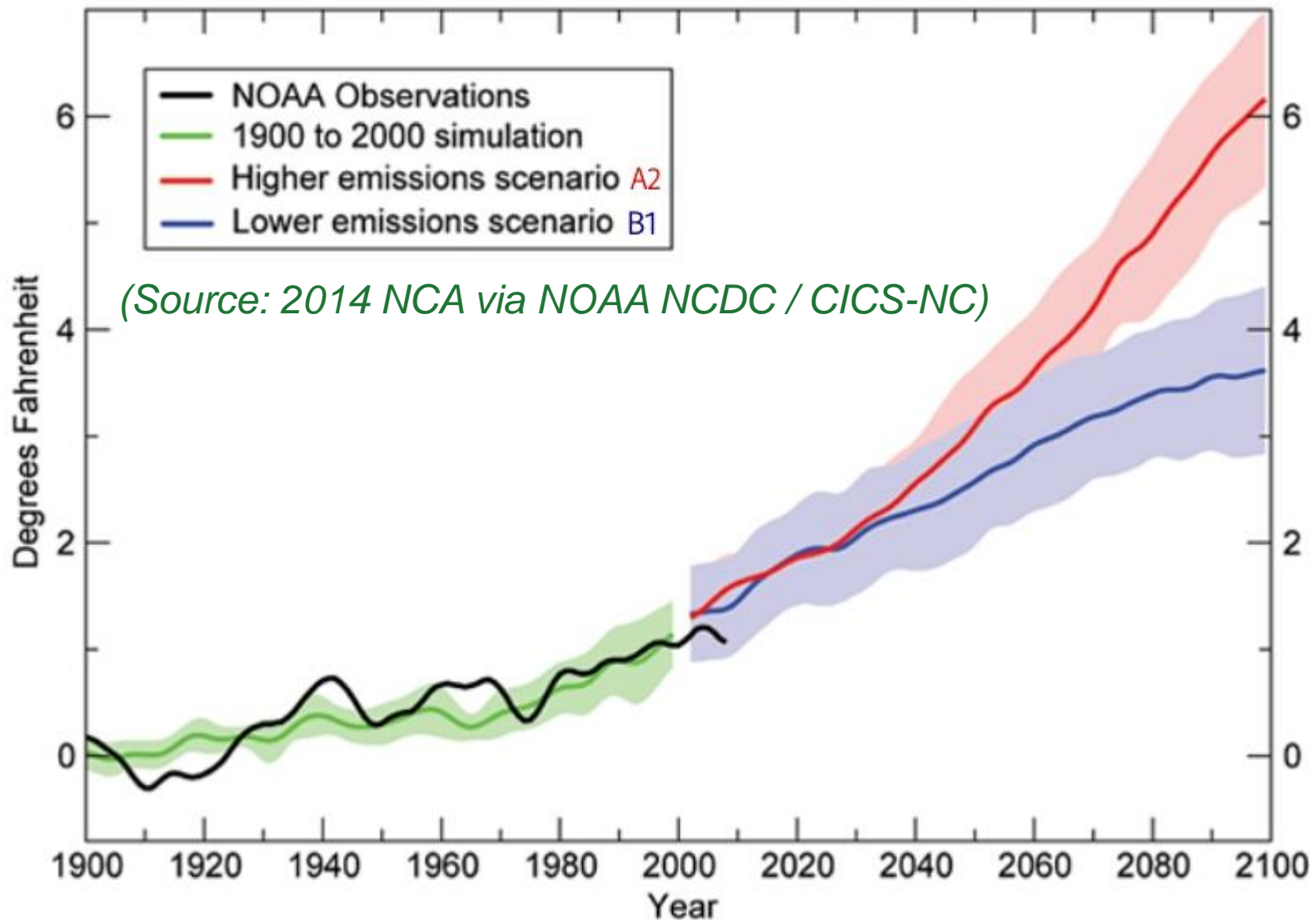
Reducing emissions of carbon dioxide (mostly from vehicles and power plants, as shown below) also indirectly reduces the emissions of noxious air pollutants such as mono-nitrogen oxides (or NO_x) and sulfur dioxide (SO_x). According to the U.S. Environmental Protection Agency (EPA), both these compounds can cause respiratory problems and hospitalizations. The above results calculate saved premature deaths from reducing NO_x and SO_x emissions in a way consistent with guidelines from EPA and other federal agencies.

Benefits to Carbon Reduction: Health, Productivity and Well-Being

Percentage Changes



Benefits to Carbon Reduction: Improved Long-Term Climate Stability



Benefits to Carbon Reduction: Community Engagement

“For the first time all the countries of the world are together on the path to save the planet ... we fought for a long time and today we’ve reached a solid agreement. It is a historic turning point.”

**German Environment Minister Barbara Hendricks, COP21
Paris Climate Accord**

Benefits to Carbon Reduction: Community Engagement

“Today’s agreement demonstrates without question that it is possible for us to come together in common cause to address the greatest challenges we face, preventing tragedy for the many millions of people vulnerable to the effects of climate change and securing the economic prosperity of the world in the 21st century.

**Paul Polman, CEO, Unilever,
COP21 Paris Climate Accord**

Benefits to Carbon Reduction: Community Engagement

“We welcome the historic agreement that has just been reached in Paris. The world has come together to forge a deal that finally reflects the aspiration, and the seriousness, to preserve our planet for future generations”

**World Bank Group President Jim Yong Kim,
COP21 Paris Climate Accord**

5. Summary

1. The climate is changing
 1. 1.8-degree F rise in temperatures since 1880
 2. 7-inch rise in sea level over past 100 years
 3. Increase in severe drought events
 4. Increase in severe rain events
 5. Decrease in Arctic ice thickness
2. Earth's atmosphere is changing
 1. Humans emit over 100 millions tons GHG/day
 2. CO₂ at 310 ppm, compared to historical 270
 3. CH₄, NO₂ and HFC's have also increased
 4. No other climatic forcing can account for T rise
3. Reducing emissions now will reduce future effects
4. A refundable carbon tax will reduce carbon emissions, improve health, and be good for the economy.

Thank you!

If not us, who? If not now, when?

- paraphrased from Hillel the Elder, approx. 50 BCE

James A. D'Aloisio
P.E., SECB, LEED AP



Klepper, Hahn & Hyatt

(315) 446-9201
jad@khhpc.com

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