HONR 229L: Climate Change: Science, Economics, and Governance

Meeting #2: Overview of Climate Change

Ross Salawitch

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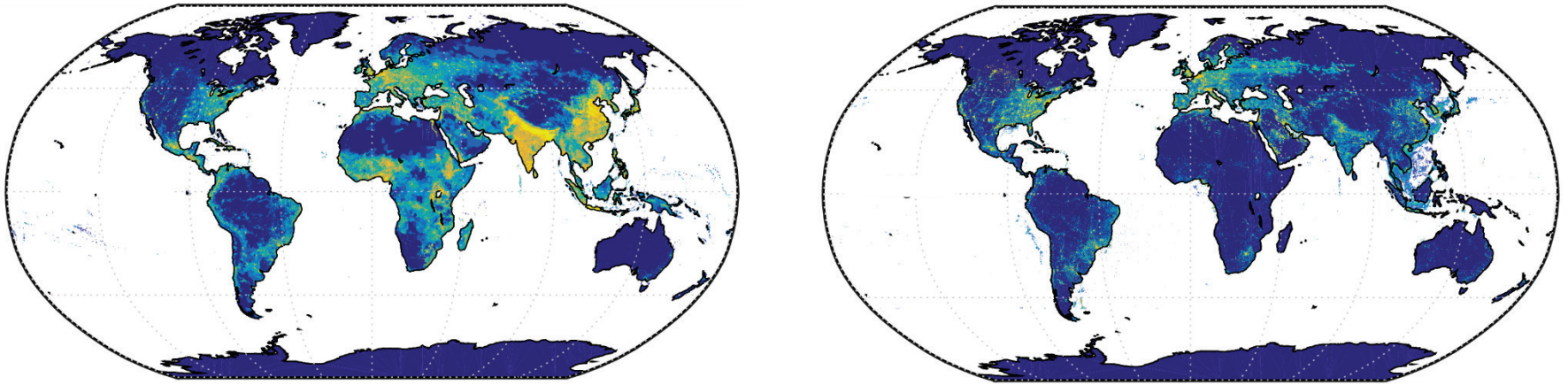
Class Web Site: http://www.atmos.umd.edu/~rjs/class/honr229L

ELMS Page: https://myelms.umd.edu/courses/1269254



Salawitch et al., *Paris Climate Agreement: Beacon of Hope*, 2017
https://link.springer.com/book/10.1007/978-3-319-46939-3

29 August 2019

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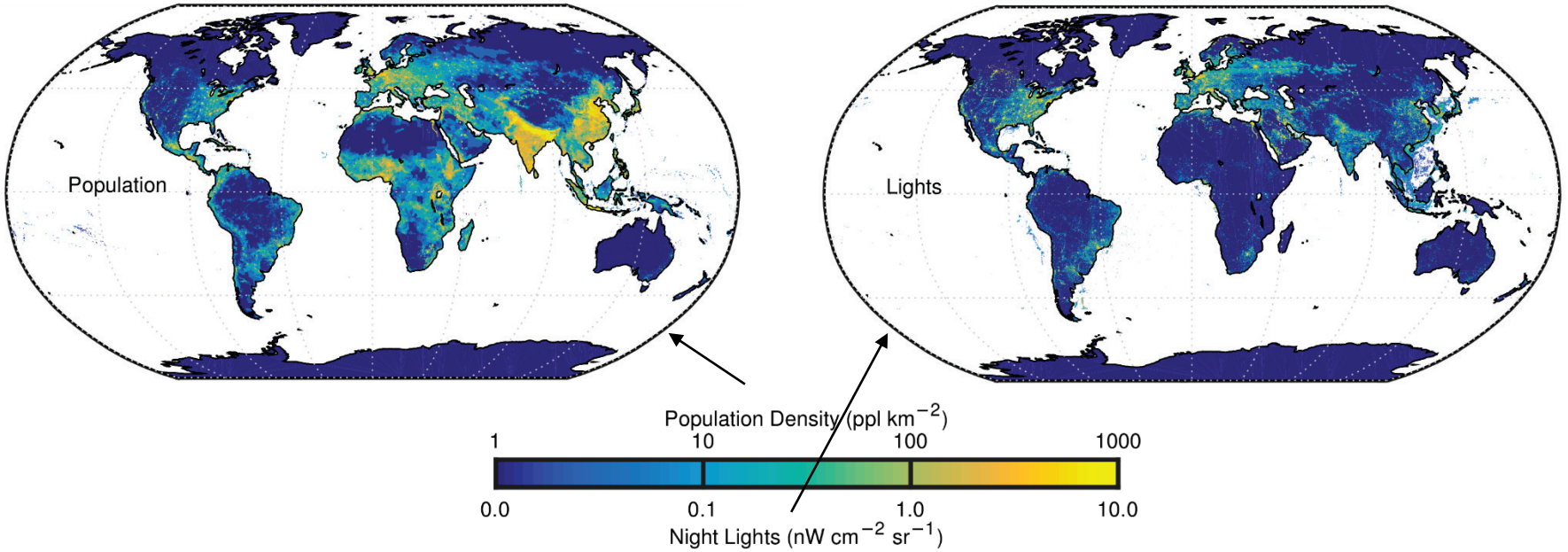


Picking Up Where We Left Off On Tuesday

Please complete:

- Admission Ticket #0 (AT 00 on website) prior to **12:25 pm on Thurs**
- Discussion leader preference survey: complete and ***bring to class*** at start of class

Loose ends:

- Projected material posted to class website I maintain, as well as video of each class meeting.
  - Access to videos restricted to students enrolled in this class
  - This will be the last time projected material will be handed out
  - Password to open protected material is _____

Action:

- How will you ***make the world a better place***

AT 00: Initial Survey

1) Where do you stand on the climate change debate? (2 pts)

In other words, are you a Believer, a Denier, or Unsure? In addition to stating where you stand on the debate, please expound upon your standing in two to three sentences.

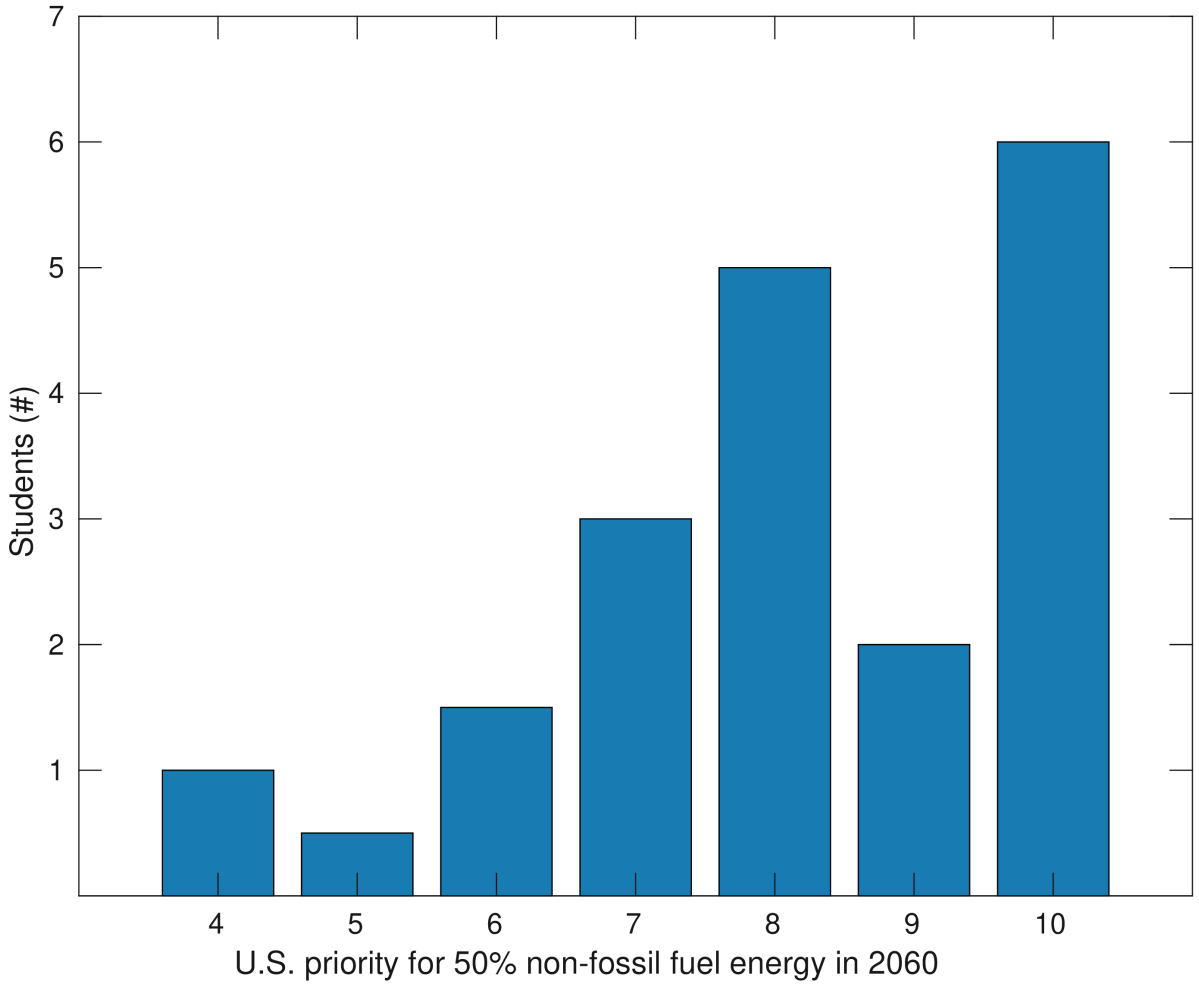
I am a strong Believer in climate change. My mind tends to lean towards scientific fact, and in this case there is an exuberant amount of numerical data supporting the climate change theory. The numerical rise of the sea level, overall temperatures, and atmospheric carbon dioxide concentration level – just to name a few – are all indicators of an evolving climate system on our planet.

Deniers are only interested in protecting their economic interests, even while doing so is destroying our planet.

On the spectrum of denier to believer, I would fall right before a believer. A believer to me means that I am super passionate about it and I am willing to take a strong stance for the existence of global warming, but I am not. However, I neither deny it nor am oblivious to it. I just think that it might not be as much of a pressing issue as it is made seem. However, this view could change because I am willing to learn more about the matter to hopefully have a more solid stance at the end of the course.

AT 00: Initial Survey

2) On a scale of 1 to 10, 1 being least important and 10 being most important, what priority should the United States government give towards curbing our nation's emissions of fossil fuels over the course of your lifetime, such that by year 2060, half of all energy in the U.S. would be achieved by renewable sources? (3 pts)



AT 00: Initial Survey

2) On a scale of 1 to 10, 1 being least important and 10 being most important, what priority should the United States government give towards curbing our nation's emissions of fossil fuels over the course of your lifetime, such that by year 2060, half of all energy in the U.S. would be achieved by renewable sources? (3 pts)

I believe that the priority level of obtaining half of all energy in the United States from renewable sources by 2060 should be a 10. This is because all of the most recent research I have seen has stated that *if we don't make major moves to turn around the climate crisis in the next 10 years*, we will do irreparable damage to the Earth. On top of this, renewable energy is getting more efficient every day which should ease the transition. Lastly, despite the current administration's failing to save at all for the future, the process of moving over to more renewable energy sources *should also produce a lot of jobs and help stimulate the economy*.

Utilizing renewable energy sources is important because it is sustainable and, unlike fossil fuels (i.e., smog), will not damage our immediate environment.

I believe the potential long-term effects of climate change, which include water shortages, agricultural devastation (Dust Bowl II, anyone?), and sea level rise (buh bye NYC) could bring down the country as we know it. We need to take action while we still can …

AT 00: Initial Survey

In terms of curbing dire effects of climate change at an international level, which of the following four factors do you think is most important:

1. designing living spaces in a sustainable manner (i.e., so that cars are not essential, locally sourced food can be consumed, etc): **2**
2. generating electricity in a manner that releases little to no greenhouse gases to the atmosphere: **10**
3. changing our dietary preferences to minimize the consumption of meat, especially red meat: **3**
4. limiting population growth and ultimately reducing global population levels: **3**

Living spaces:

I think that designing living spaces in a sustainable manner is the most important factor in addressing climate change on an international level … living spaces should be designed to use renewable sources of energy and not fossil fuels. In the scope of my community in the suburbs of Maryland, I know that many people rely on gasoline to use in cars or other modes of transportation and there is not efficient public transportation.

If efficient, accessible, and affordable sources of renewable energy **could be used in place of fossil fuels in homes, public buildings, businesses, large corporations, and** ***for transportation*****, I think that this could play a large role in curbing the effects of climate change.**

AT 00: Initial Survey

In terms of curbing dire effects of climate change at an international level, which of the following four factors do you think is most important:

1. designing living spaces in a sustainable manner (i.e., so that cars are not essential, locally sourced food can be consumed, etc): **2**
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3. changing our dietary preferences to minimize the consumption of meat, especially red meat: **3**
4. limiting population growth and ultimately reducing global population levels: **3**

Electricity:

Generating electricity in a sustainable way (with no greenhouse gas output) is the most important factor in curbing the effects of climate change. People around the world (especially in the West) depend on using large amounts of electricity every day, which obviously has detrimental effects on the climate. *Unless people are willing to change this lifestyle, we need a way to support this use of energy without adding anymore greenhouse gasses to the atmosphere*.

AT 00: Initial Survey

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Diet:

I would probably say the most important one of these factors would be *limiting consumption of red meat*. This is because not only are there huge amounts of carbon emissions put off by cows, but also *the deforestation that is done to allow the cows space to graze*. Combating this issue would help not only limit emissions but also allow more vegetation to consume carbon, thus fighting climate change on two fronts. Additionally, with the new additions of vegan beef becoming cheaper and lab grown meat becoming more of a possibility, there should be less resistance for this path.

AT 00: Initial Survey

In terms of curbing dire effects of climate change at an international level, which of the following four factors do you think is most important:

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4. limiting population growth and ultimately reducing global population levels: **3**

Population:

I think that the most important factor is limiting population growth and ultimately reducing global population levels. I believe this to be the most important because obviously as the population of the planet has increased, the overall carbon being produced by the population has increased as well, potentially leading to climate change. By curbing population growth and trying to in a way *create our own "carrying capacity" we should be able to ensure that emission levels do not continue to increase* in the future and remain where they are currently.

AT 00: Initial Survey

In terms of curbing dire effects of climate change at an international level, which of the following four factors do you think is most important:

1. designing living spaces in a sustainable manner (i.e., so that cars are not essential, locally sourced food can be consumed, etc): **2**
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All of these items are important! Will touch upon each at some point during this presentation, and each will be discussed throughout this semester.

Please note the authority responsible for each action differs:

1. Mayors & urban planners ⇨ smart growth

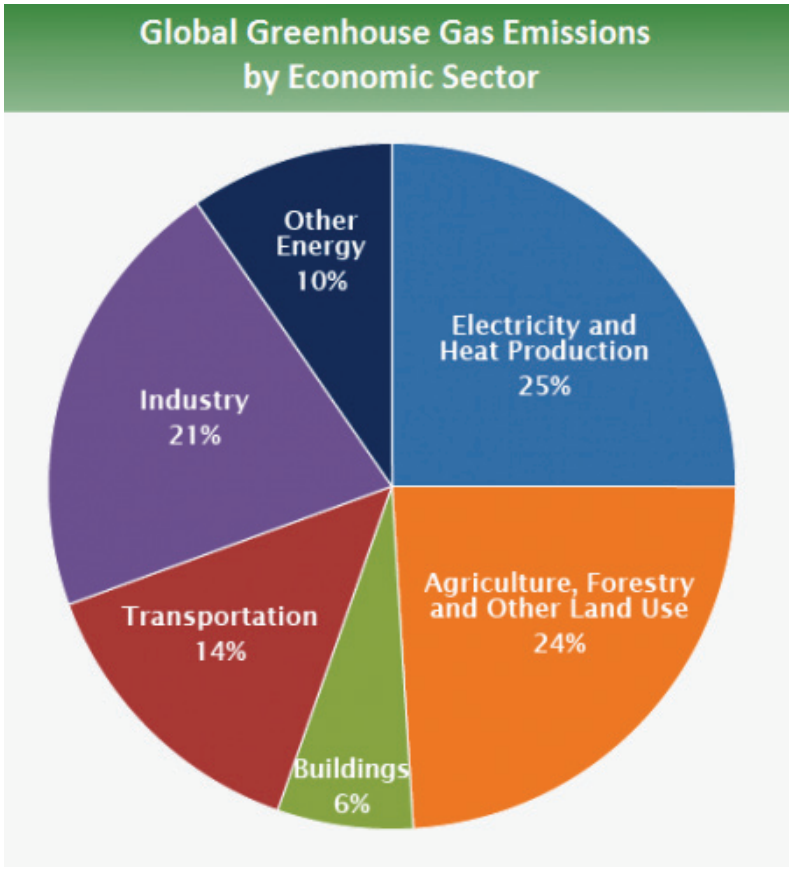
2. National and state governments, utilities, public service commissions ⇨ carbon tax

3. Individuals ⇨ health, religion, culture, ethics

4. Individuals *BUT* sometimes attempted by governments ⇨ very controversial

If diet is the so-called "elephant in the room" when discussing climate change, then planned population growth control is the proverbial "herd of elephants"

GHG emissions by sector



https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

Earth's Climate History: The Long View

Temperature Well Correlated With CO_2

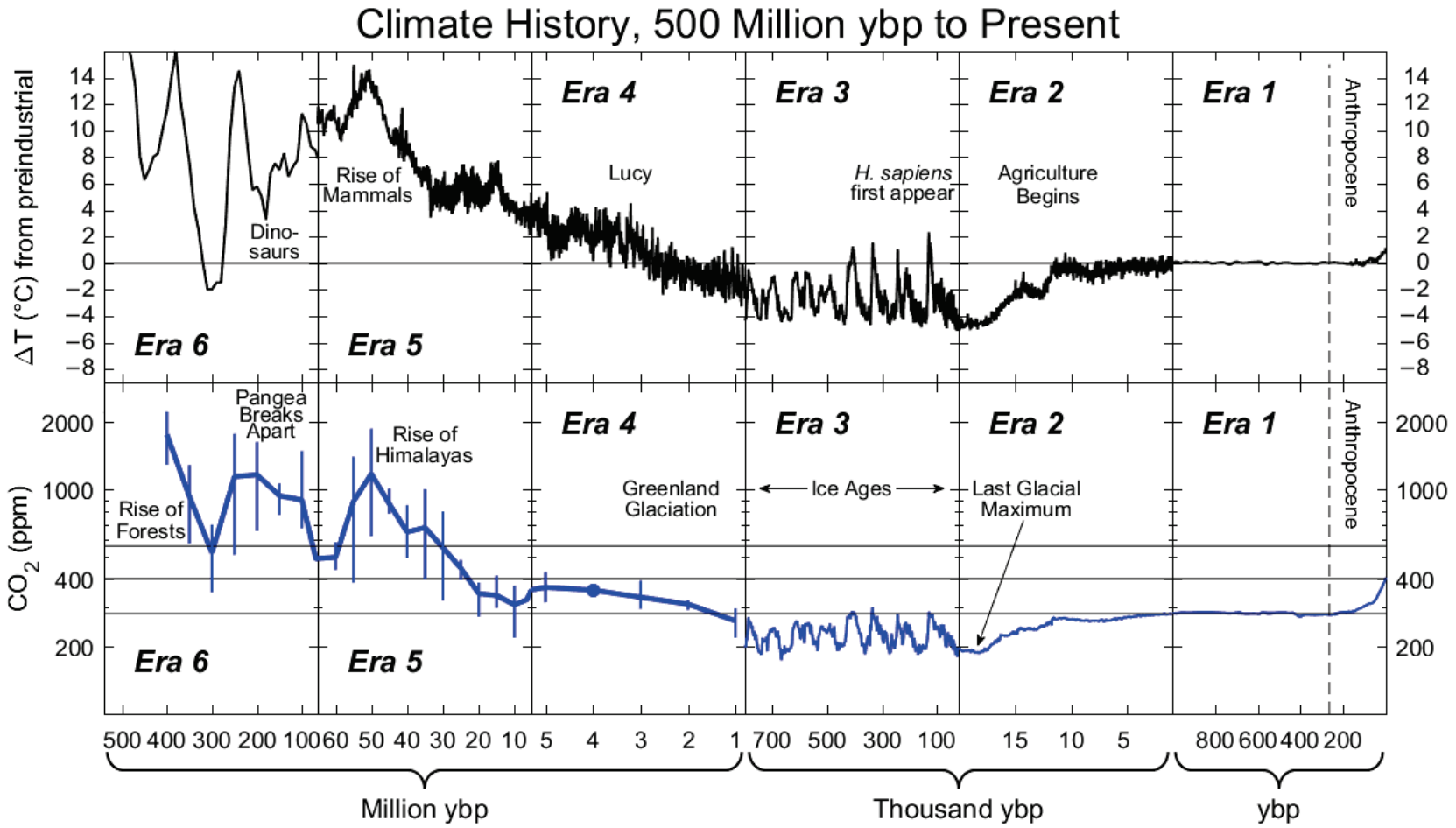


Figure 1.1, updated

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

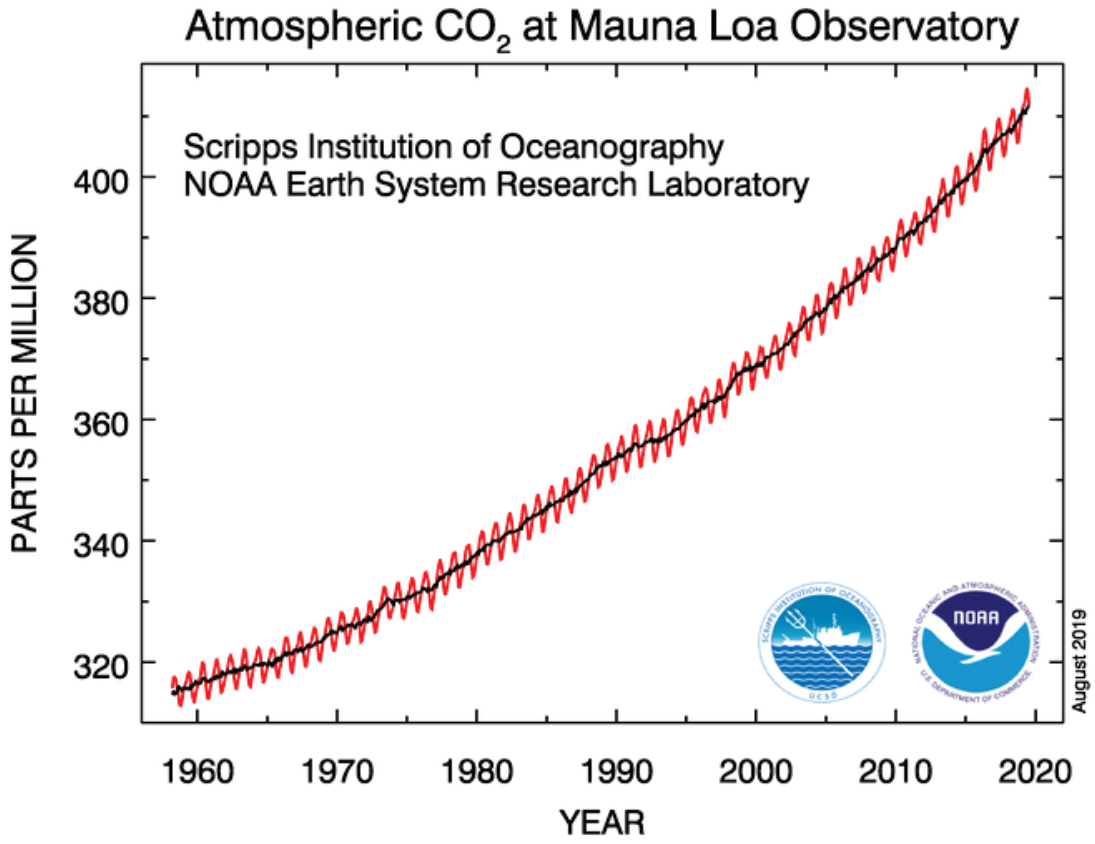
Carbon Dioxide (CO_2): Modern Era : The Keeling Curve

Combustion:

Gasoline (octane) $2\ C_8H_{18} + 25\ O_2 + \text{Small Source of Energy} \rightarrow 16\ CO_2 + 18\ H_2O + \text{Lots of Energy}$

Natural gas (methane) $CH_4 + 2\ O_2 + \text{Small Source of Energy} \rightarrow CO_2 + 2\ H_2O + \text{Lots of Energy}$

Coal $C_{135}H_{96}O_9NS + 309\ O_2 + \text{Small Source of Energy} \rightarrow 135\ CO_2 + 48\ H_2O + \text{Lots of Energy} + \text{Other Pollutants}$



http://www.esrl.noaa.gov/gmd/ccgg/trends/full.html

Carbon Dioxide (CO_2): Modern Era : The Keeling Curve

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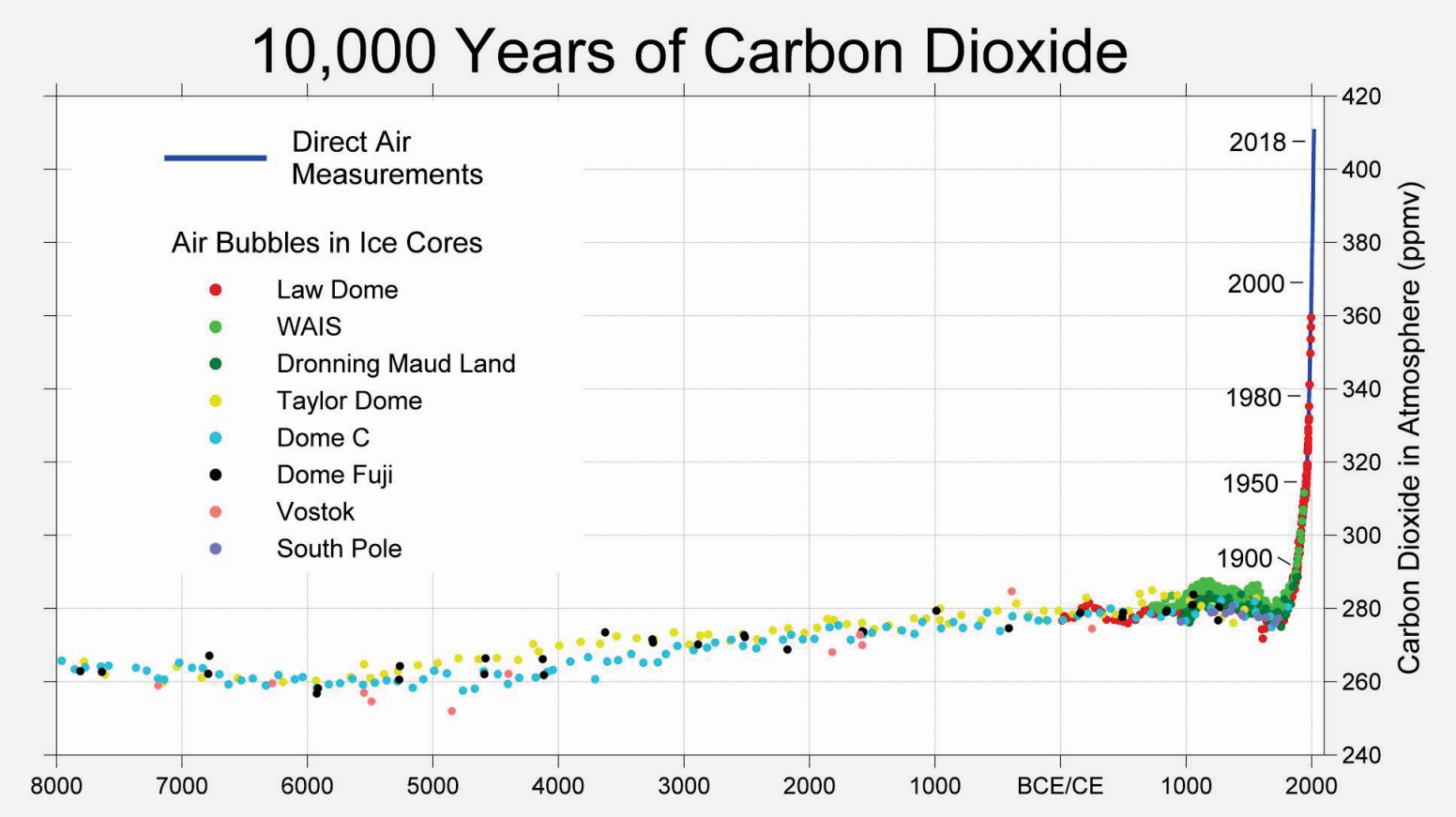
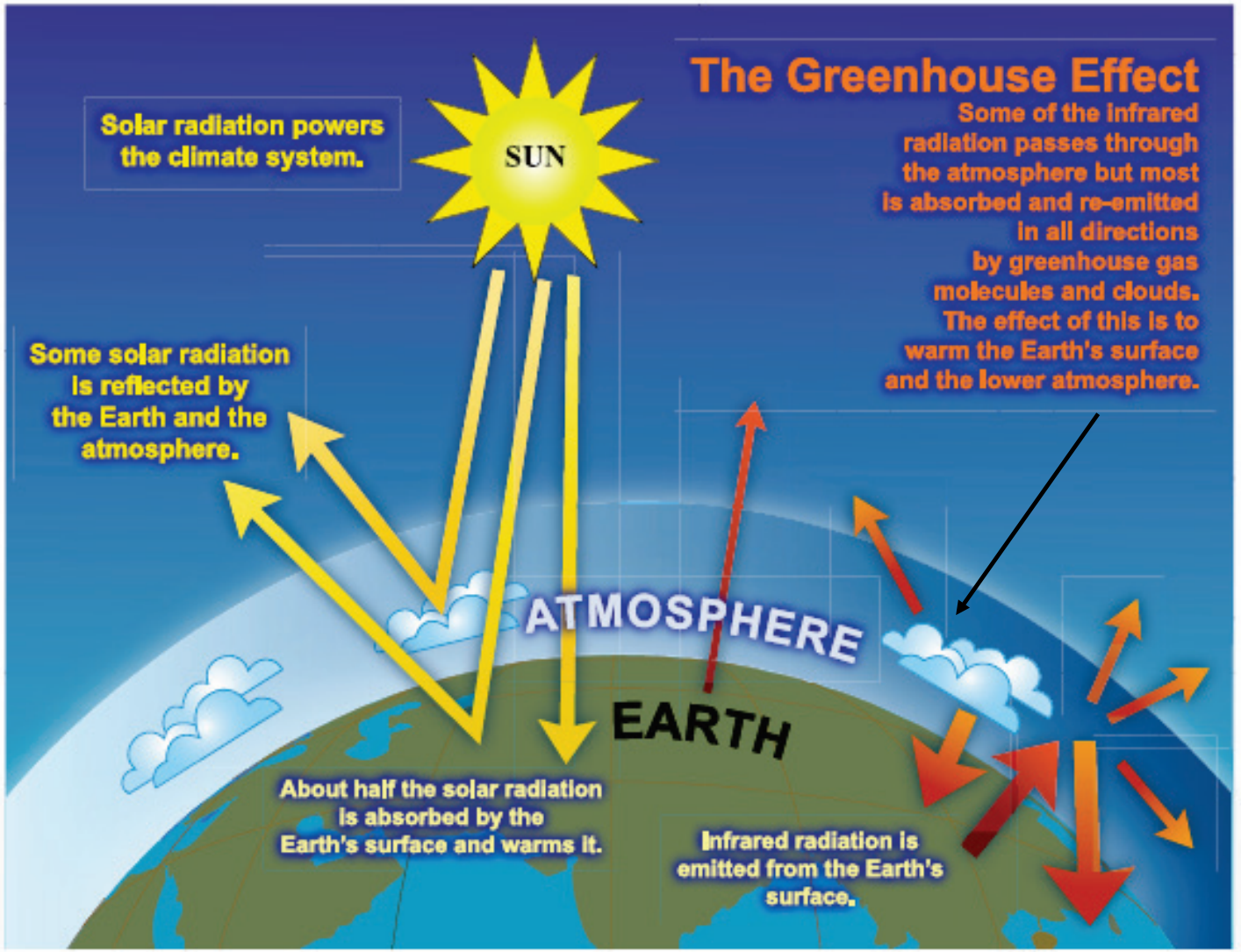


https://twitter.com/RARohde/status/1166645164477231104/photo/1

Robert Rohde: https://twitter.com/RARohde

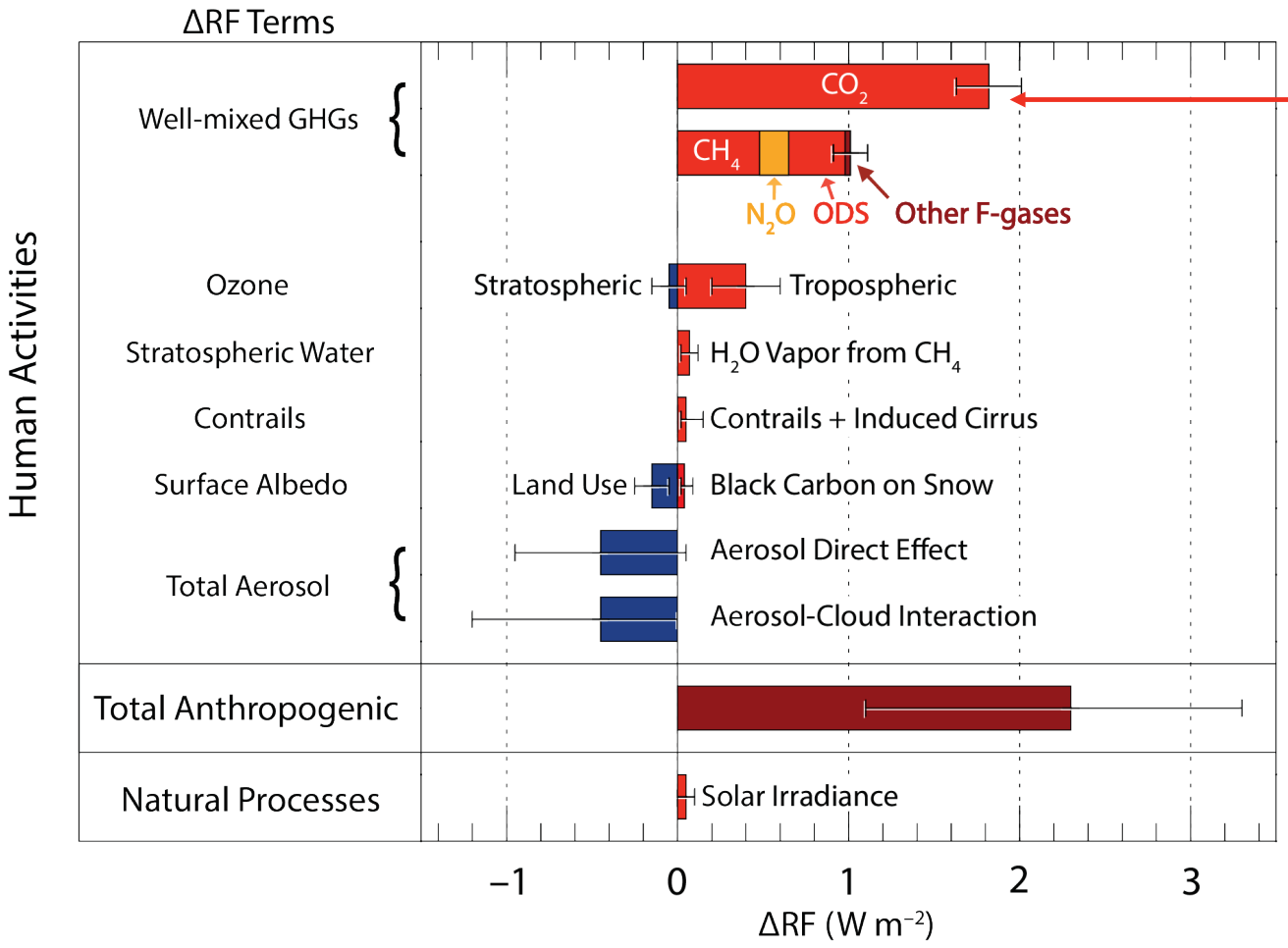
Radiative Forcing of Climate



FAQ 1.3, Figure 1. *An idealised model of the natural greenhouse effect. See text for explanation.*

Question 1.3, IPCC, 2007

ΔRadiative Forcing of Climate: 1750 to 2011

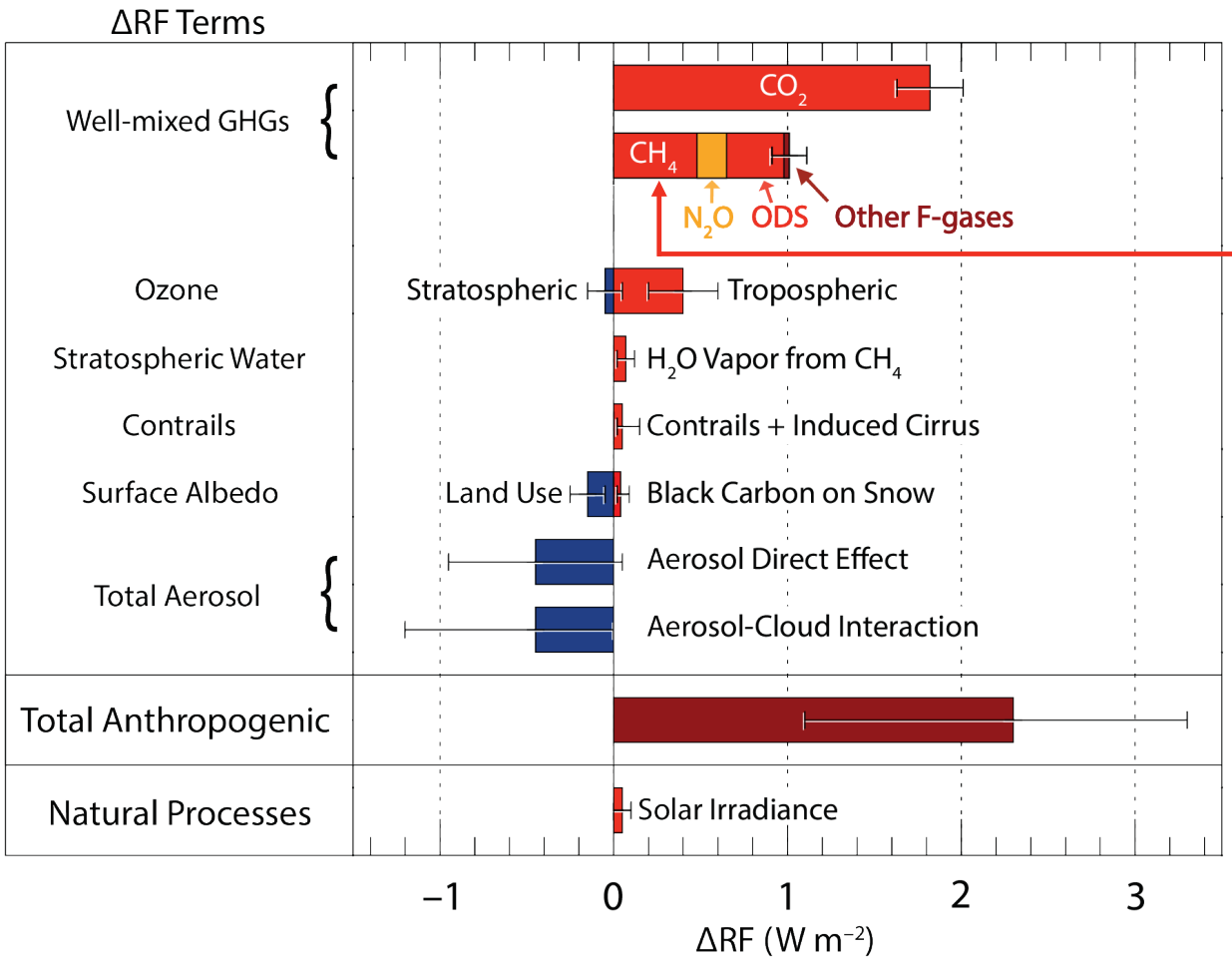


CO_2 is dominant anthropogenic (human) greenhouse gas (GHG). Once released, CO_2 persists in the atmosphere for hundreds of years.

Figure 1.4

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

ΔRadiative Forcing of Climate: 1750 to 2011



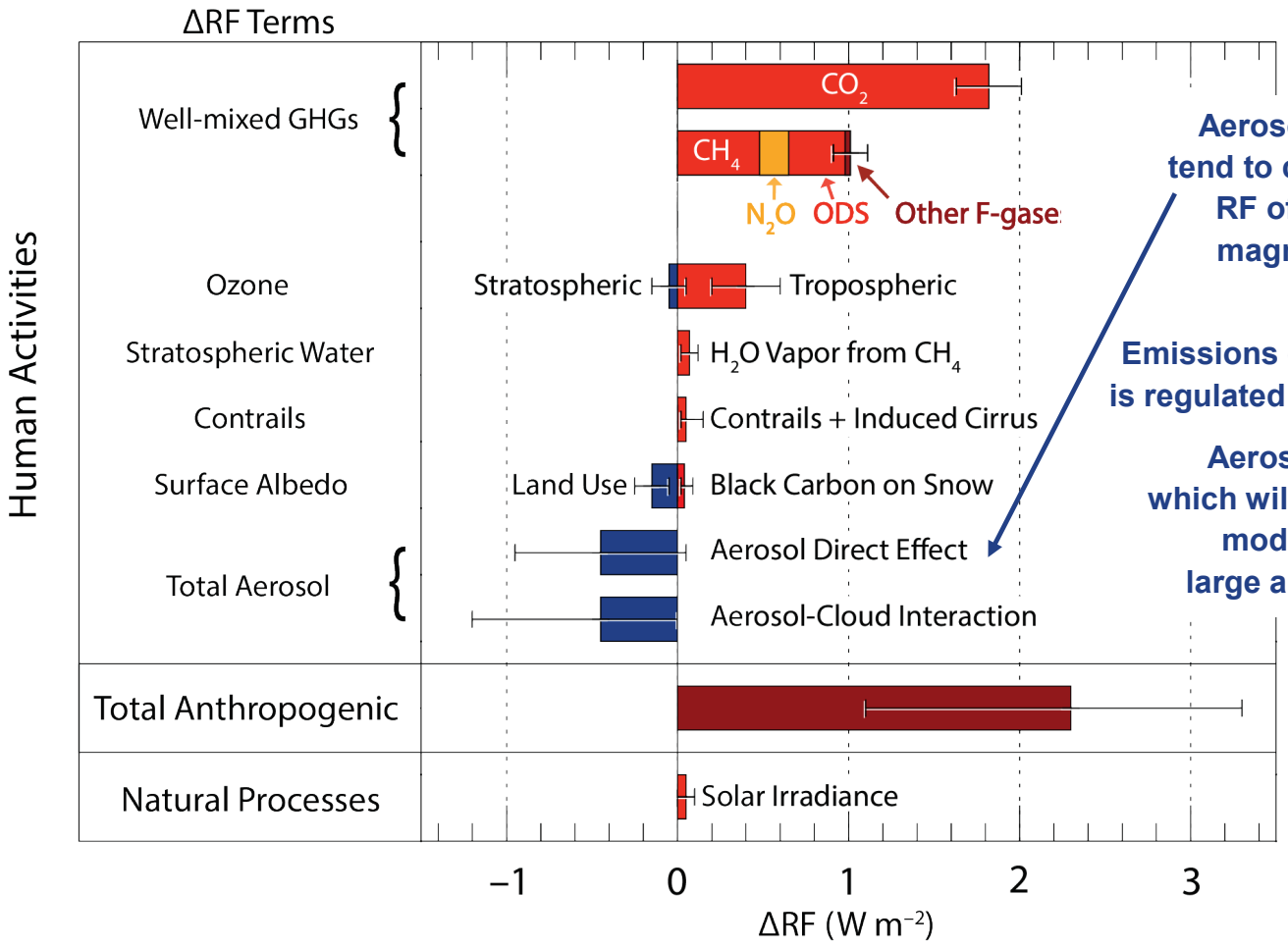
Methane (CH_4) is the 2nd most important human GHG. Once released, CH_4 persists in the atmosphere for about decade.

On a per molecule basis, CH_4 causes 30 times more warming than CO_2 (over a 20-yr time horizon)

Figure 1.4

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

ΔRadiative Forcing of Climate: 1750 to 2011



Aerosols (small particulate matter) tend to cool climate, counteracting the RF of climate due to GHGs. The magnitude of this counteraction is not well known.

Emissions of pollutants that lead to aerosols is regulated worldwide by air quality agencies.

Aerosol levels are on the decline, which will unleash either a small amount, moderate amount, or perhaps a large amount of additional warming.

Figure 1.4

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

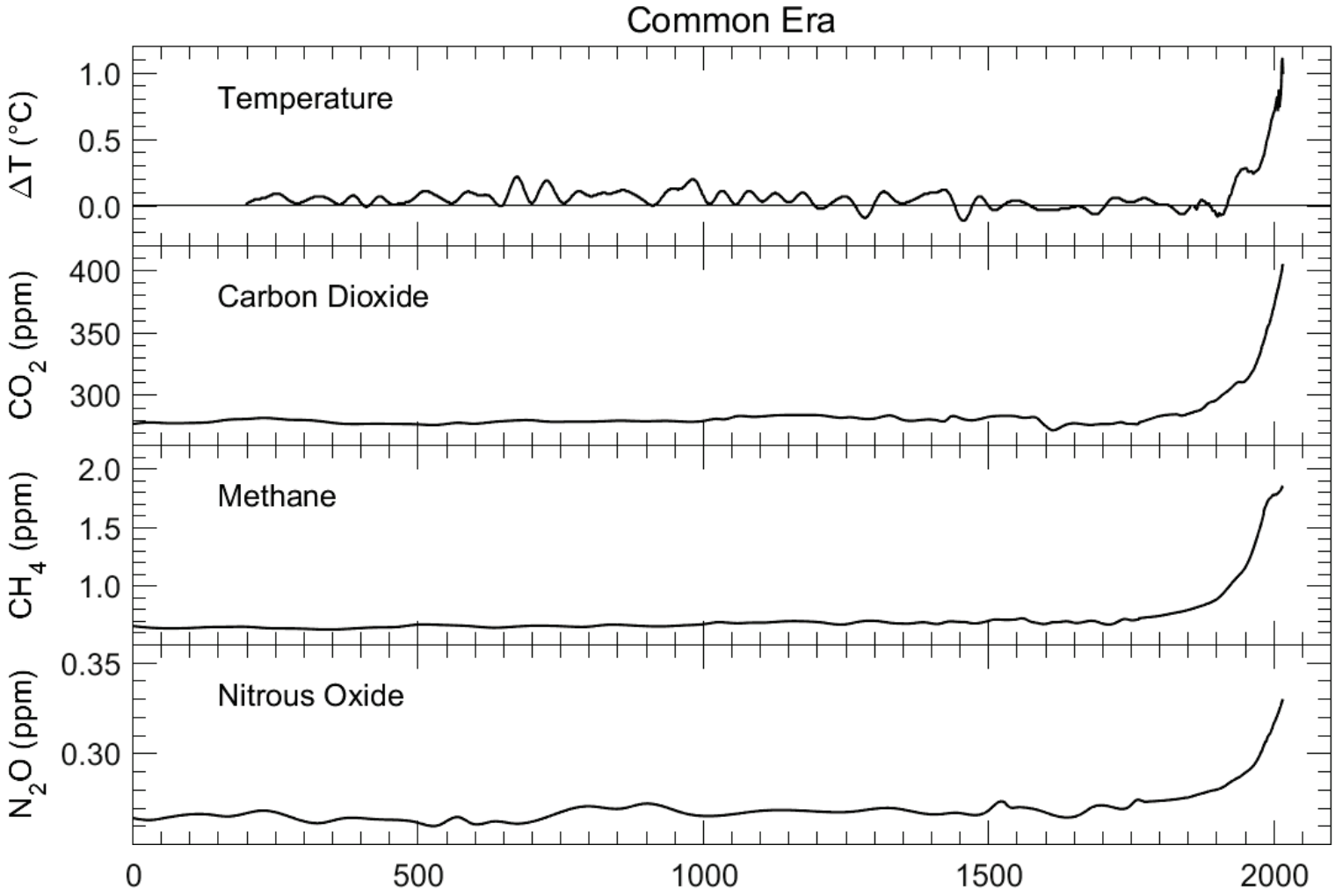
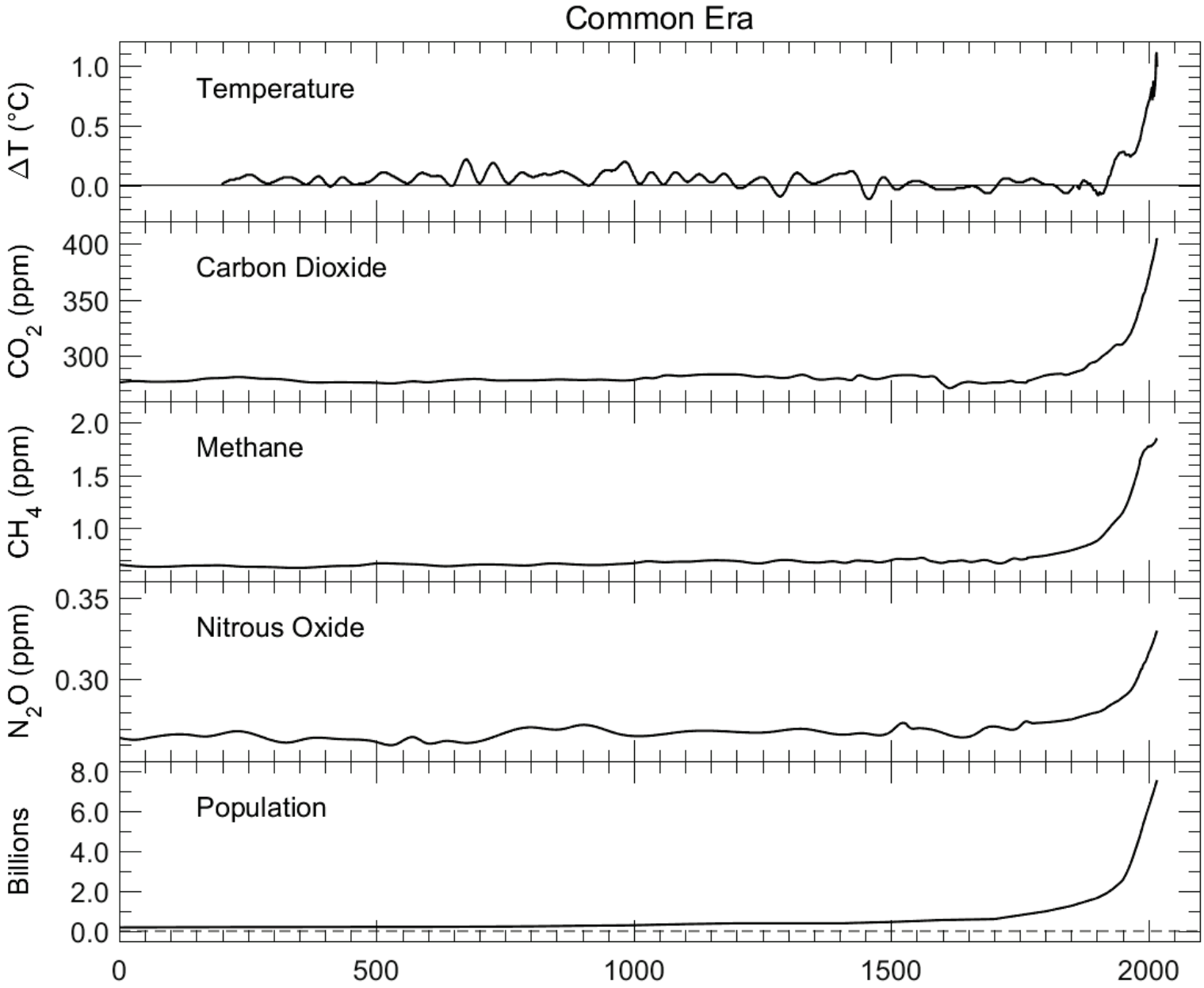


Figure 1.2, updated

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.



Salawitch *et al*., Paris Climate Agreement: Beacon of Hope, 2017.

Global Emissions of CO_2 as well as per-person (per-capita) emissions

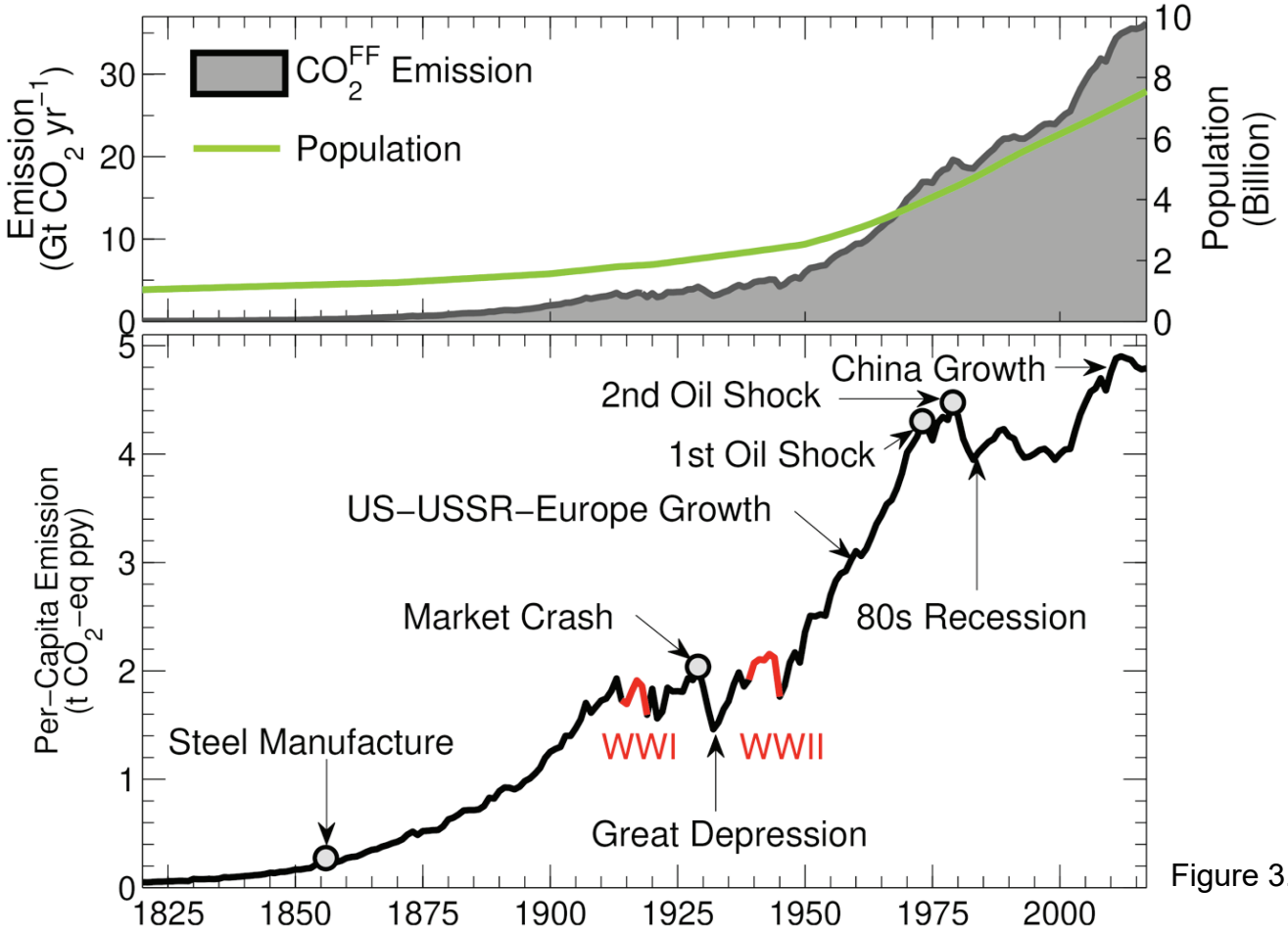
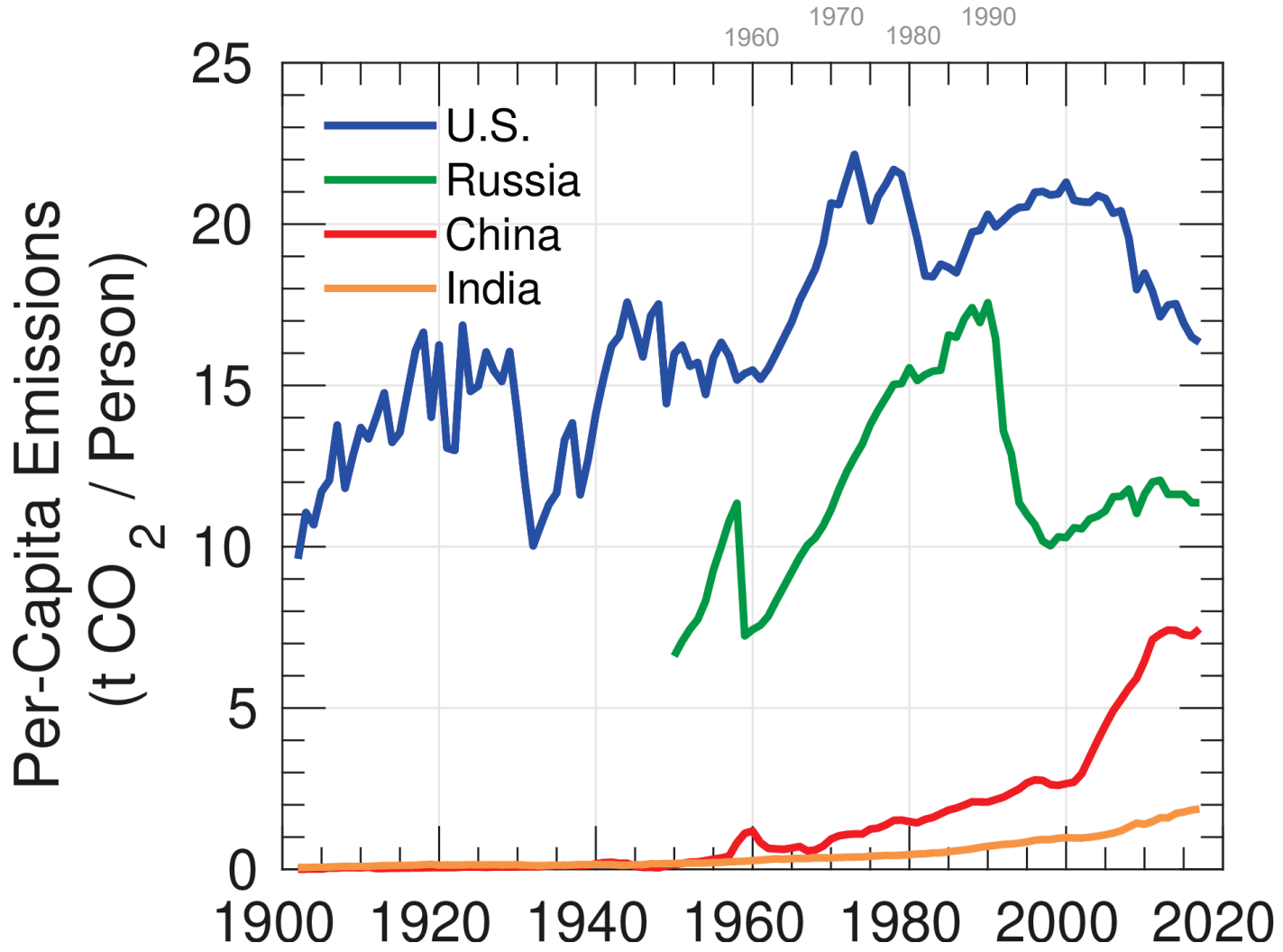


Figure 3.1, updated

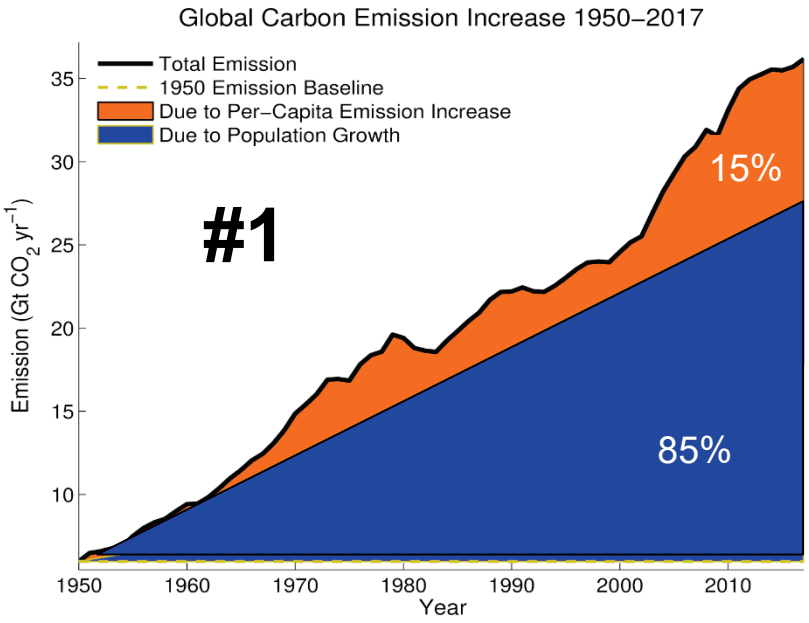
1 Gt is 10^9 tons, or a billion tons. Collectively,

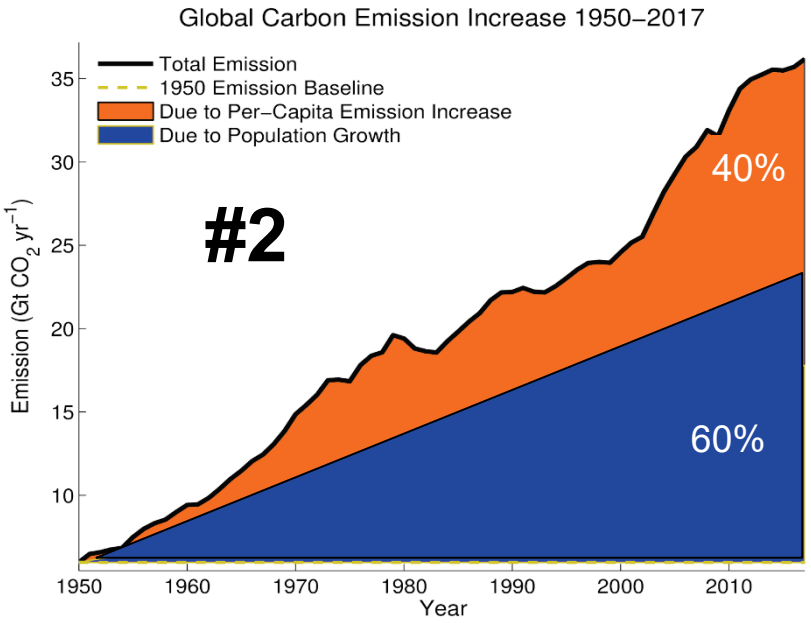
Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

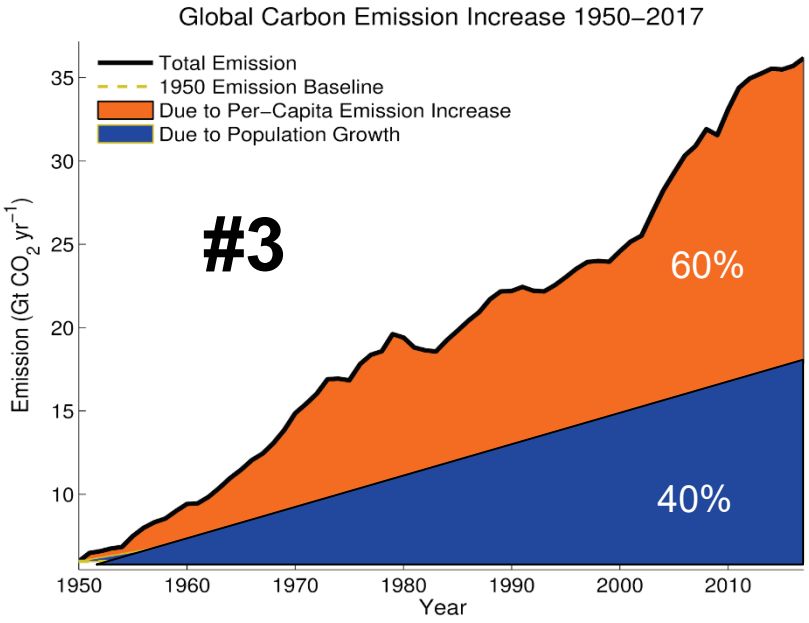
Per-Capita Emission of CO_2, Big Four, 1902 to present

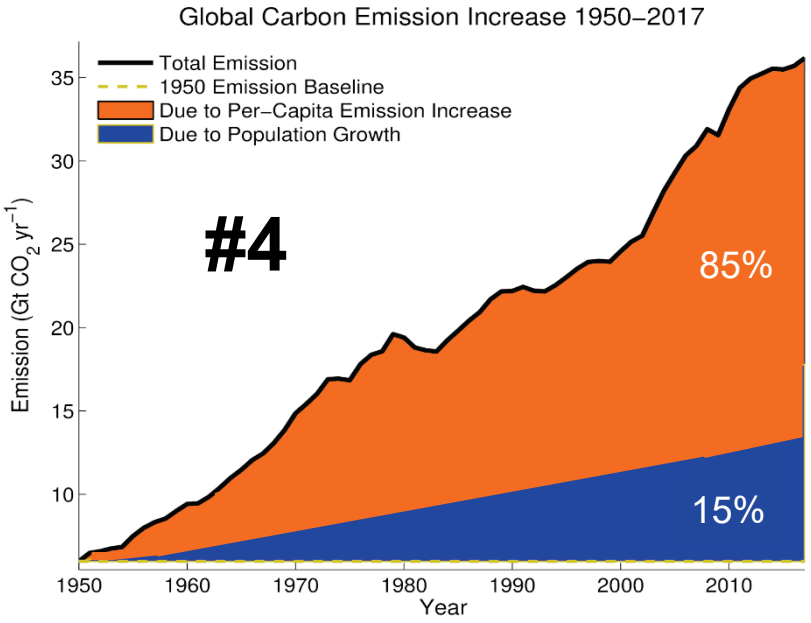


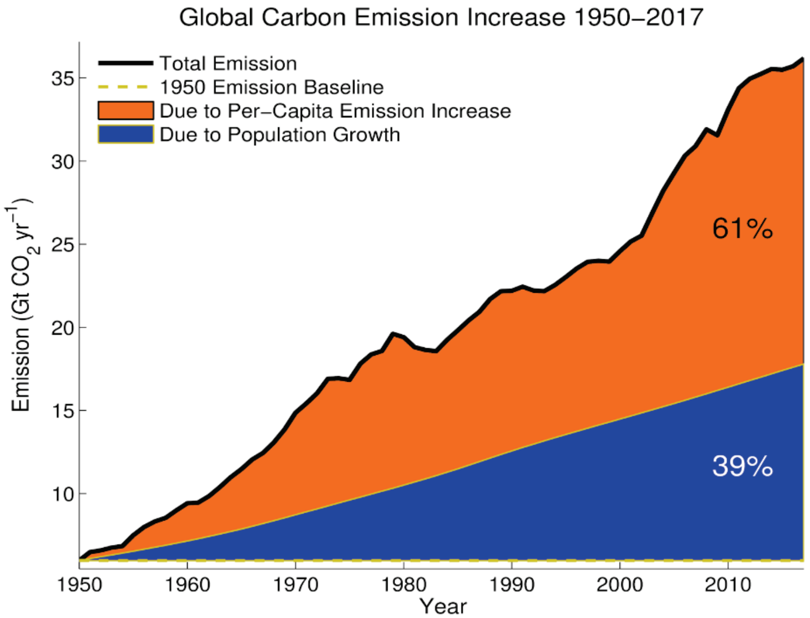
Data Source: Carbon Dioxide Information Analysis Center (CDIAC)
http://cdiac.ornl.gov/trends/emis/overview_2011.html

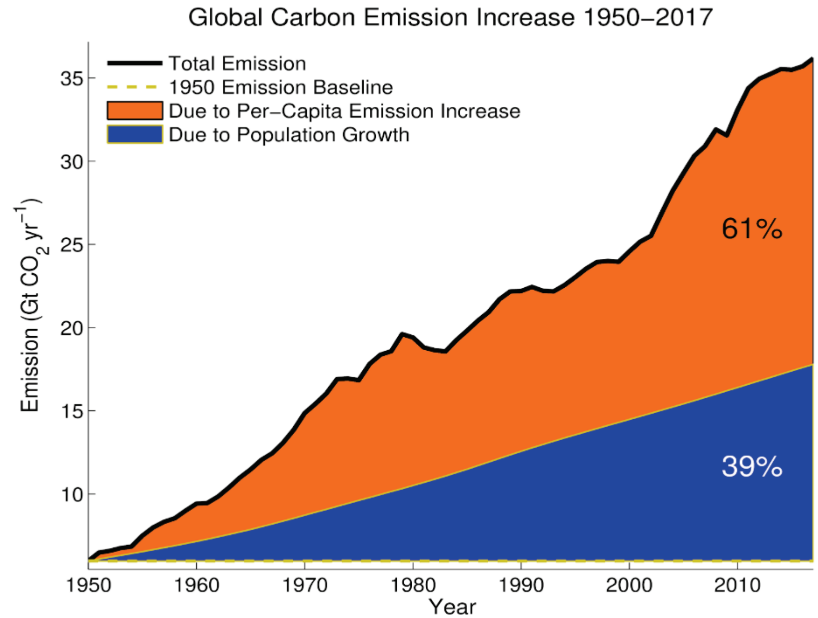


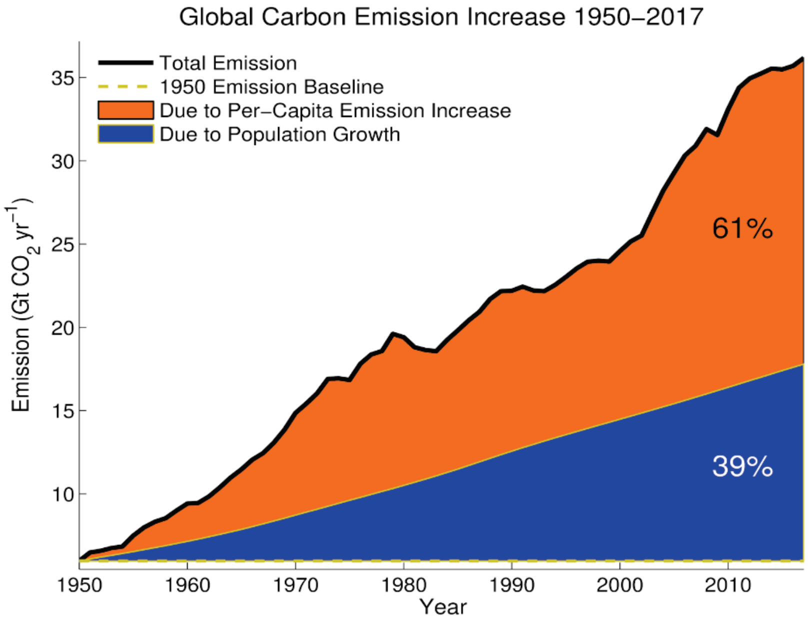


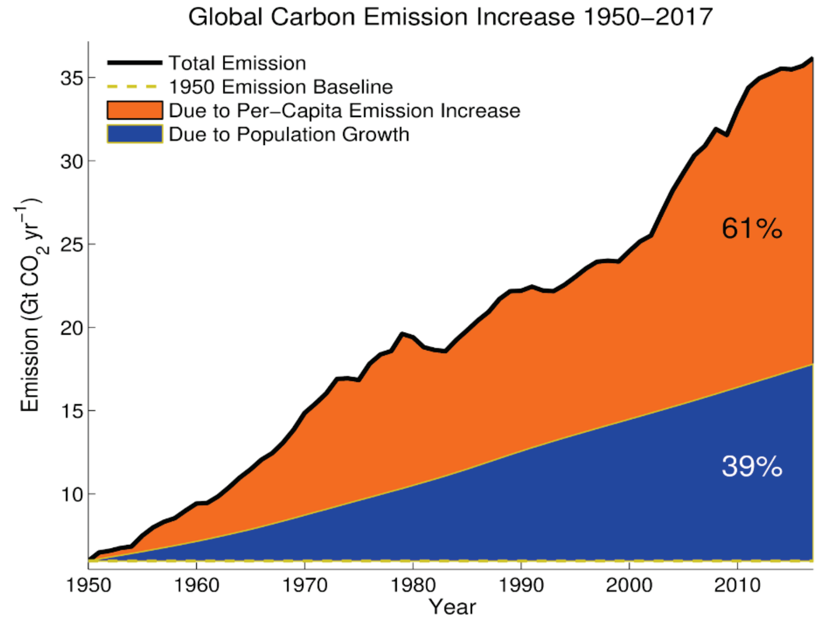












Radiative Forcing of Climate and Rise of Global Mean Surface Temperature (GMST)

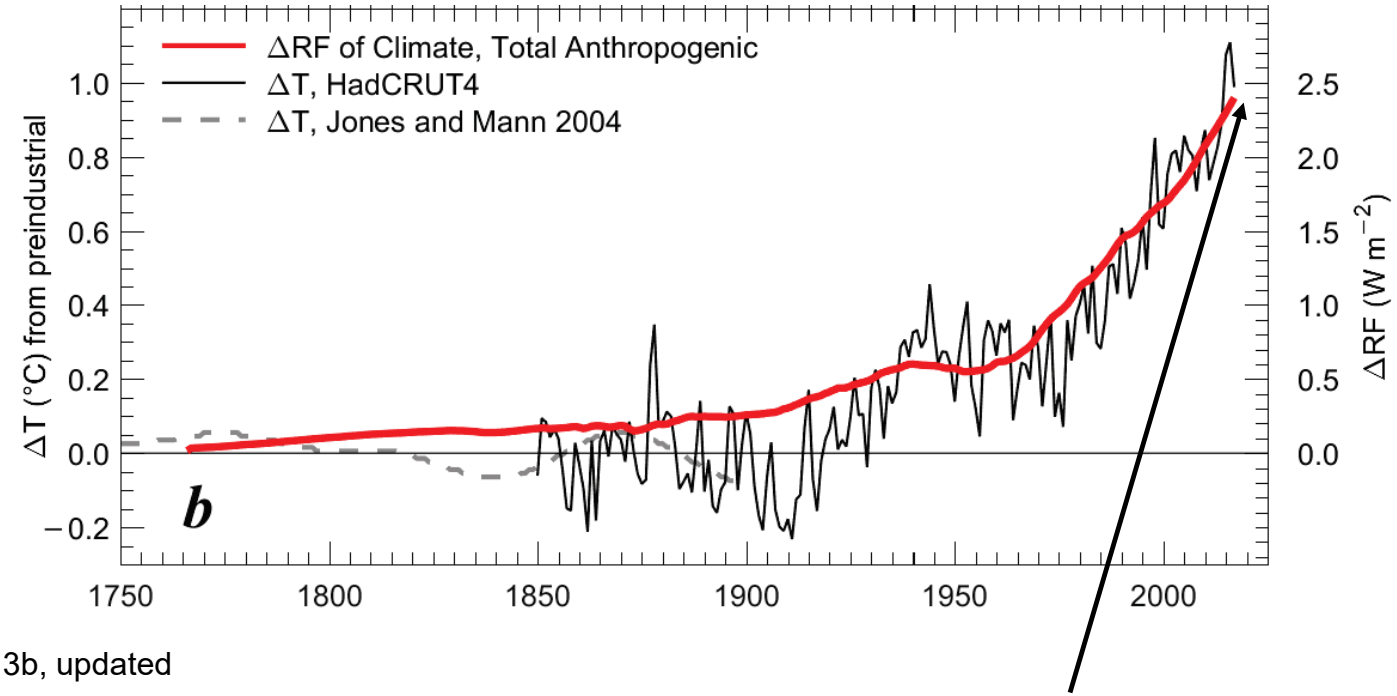


Figure 1.3b, updated

Presently, GMST has risen by about 1°C (equivalent to 1.8°F)

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

Evidence Rise in CO_2 is Caused by Humans

Difference in CO_2 between measurements made at Hawaii (MLO, or Mauna Loa) & South Pole (SPO)

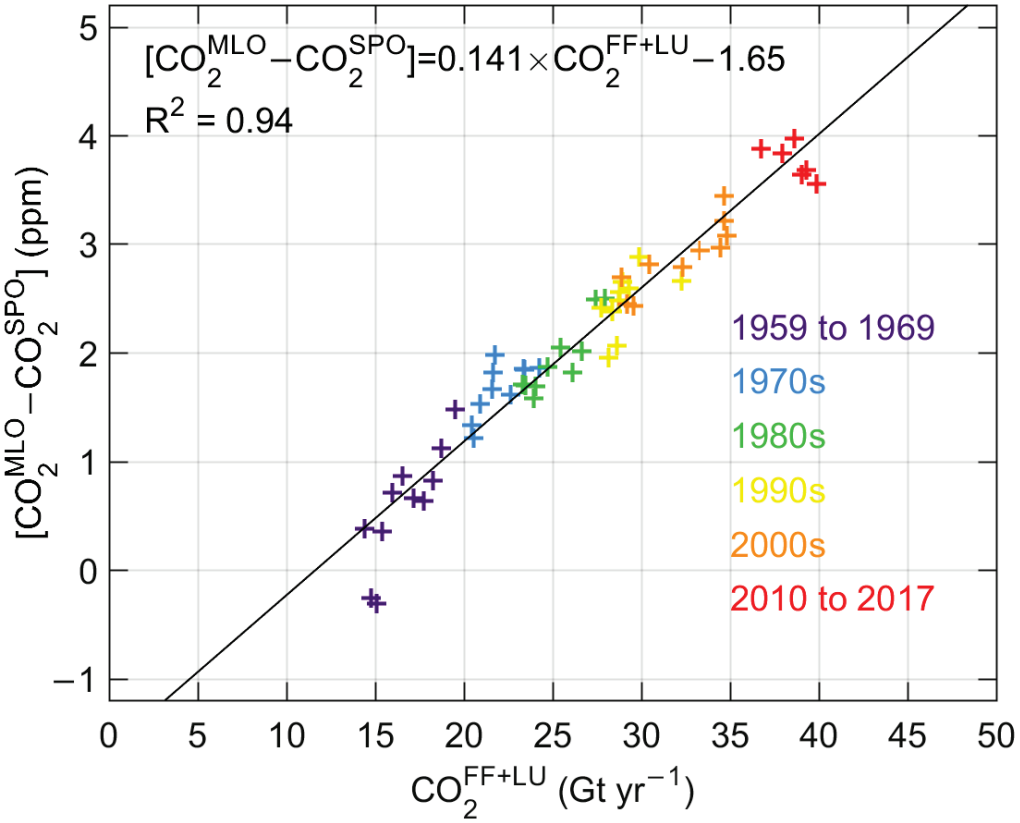
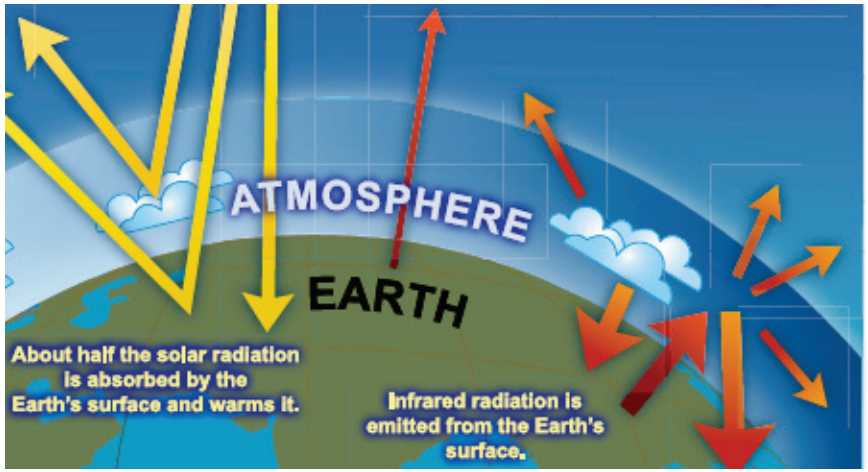


Figure 1.8, updated

Emission of CO_2 from Burning of Fossil Fuels (FF) & Land Use Change (LU)
Note: Deforestation is the primary component of LU

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

Evidence Rise in Temperature is Caused by Humans, #1



More trapping of energy in the lower atmosphere
by rising concentrations of GHGs
leads to less energy reaching the upper atmosphere,
which in turn cools

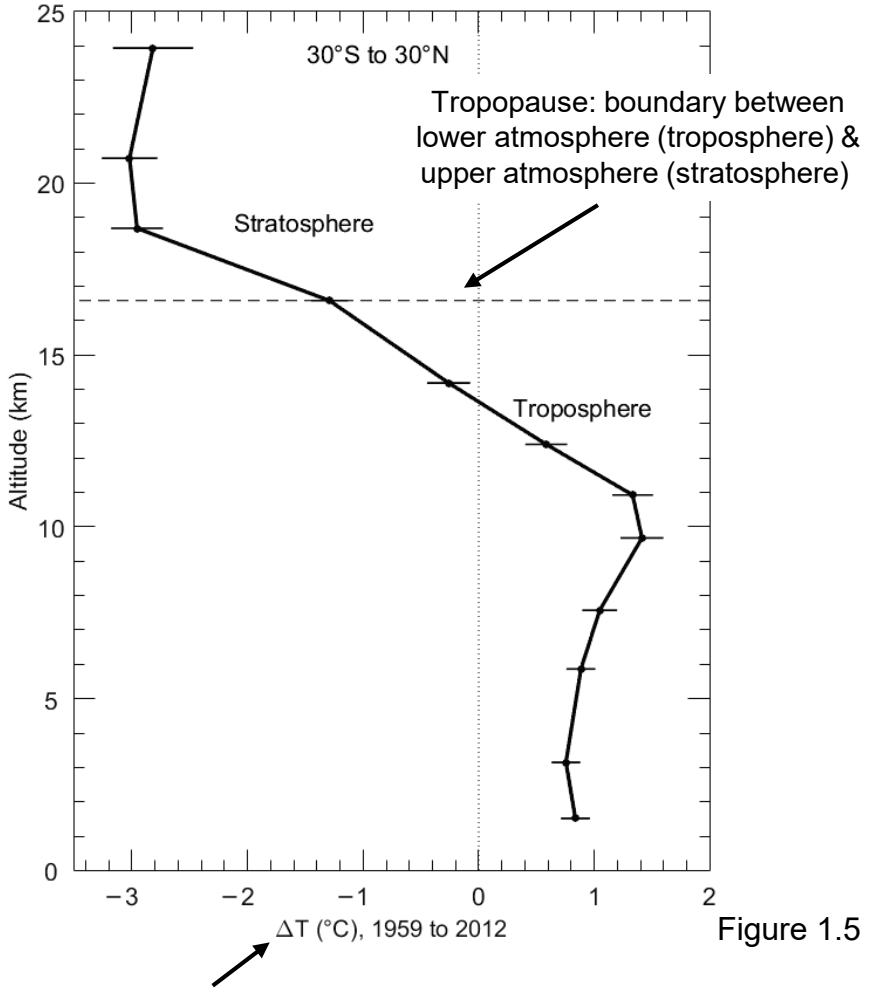


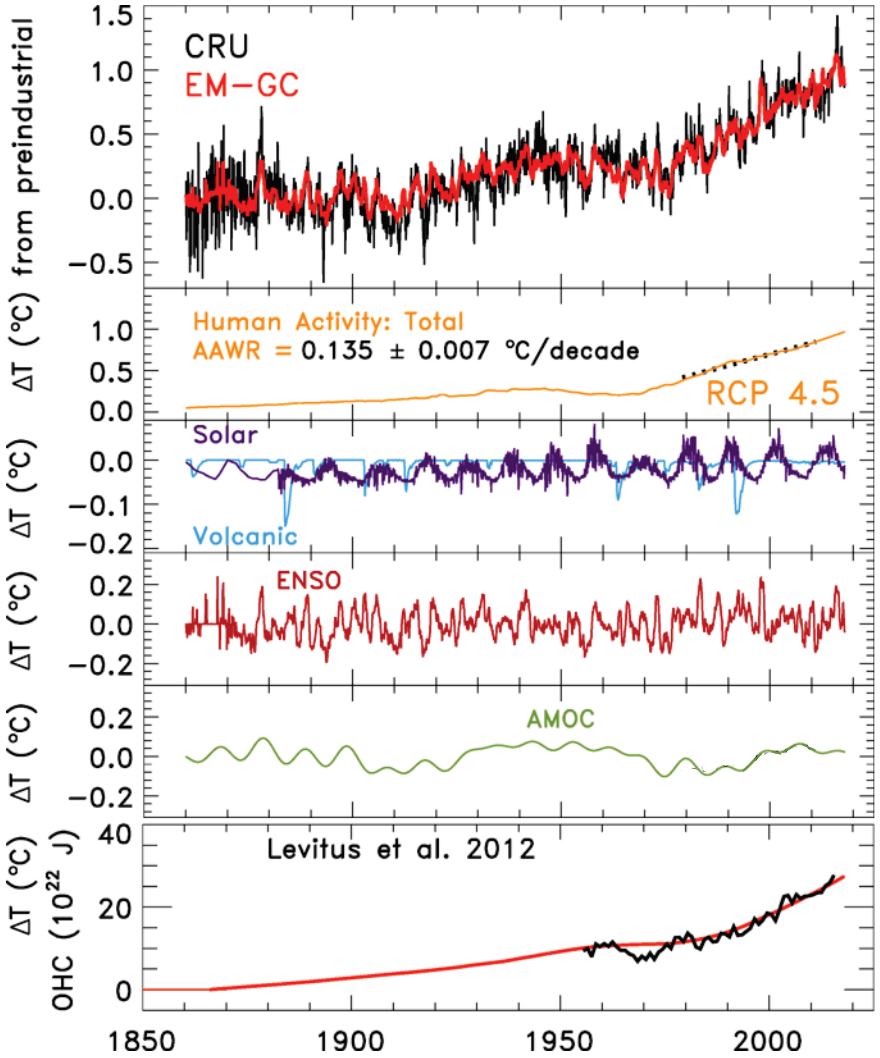
Figure 1.5

Rise in temperature based on radiosonde
(balloon-borne temperature measurements)
used mainly for weather forecasting

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

Evidence Rise in Temperature is Caused by Humans, #2

Detailed model of effects on global temperature of variations in solar output, major volcanic eruptions, natural events such as ENSO and variations in the strength of the Atlantic Meridional Overturning Circulation (AMOC), as well as human activity shows close quantitative agreement between modeled and measured rise in global temperature



Top panel:
RED is model
BLACK is data

Figure 3.3 of 2017 US National Climate Assessment Report https://science2017.globalchange.gov is based on results from the University of Maryland Empirical Model of Global Climate (EM-GC)

Paris Climate Agreement, Dec 2015:

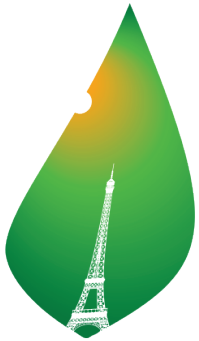
Article 2, Section 1, Part a):

Objective to hold "increase in GMST to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels"

INDC: **I**ntended **N**ationally **D**etermined **C**ontributions to reduce GHG emissions

- Submitted prior to COP21-UNFCCC meeting in Paris
- Extend from present to year **2030**

GMST: Global Mean Surface Temperature
COP: Conference of the Parties
UNFCCC: United Nations Framework Convention on Climate Change



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

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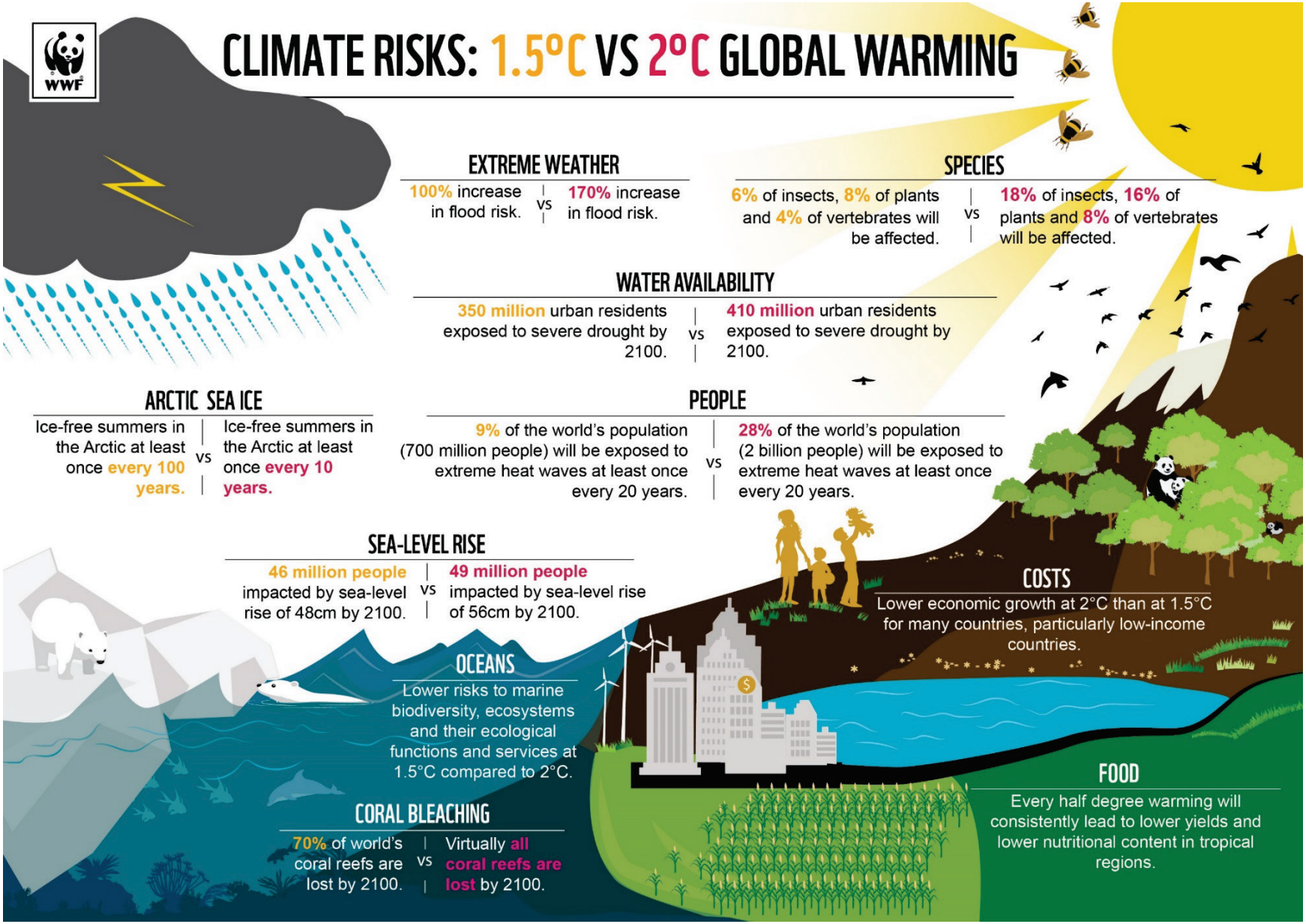
GMST: Global Mean Surface Temperature
COP: Conference of the Parties
UNFCCC: United Nations Framework Convention on Climate Change

Nov 2014:

Presidents Obama & Xi announce:

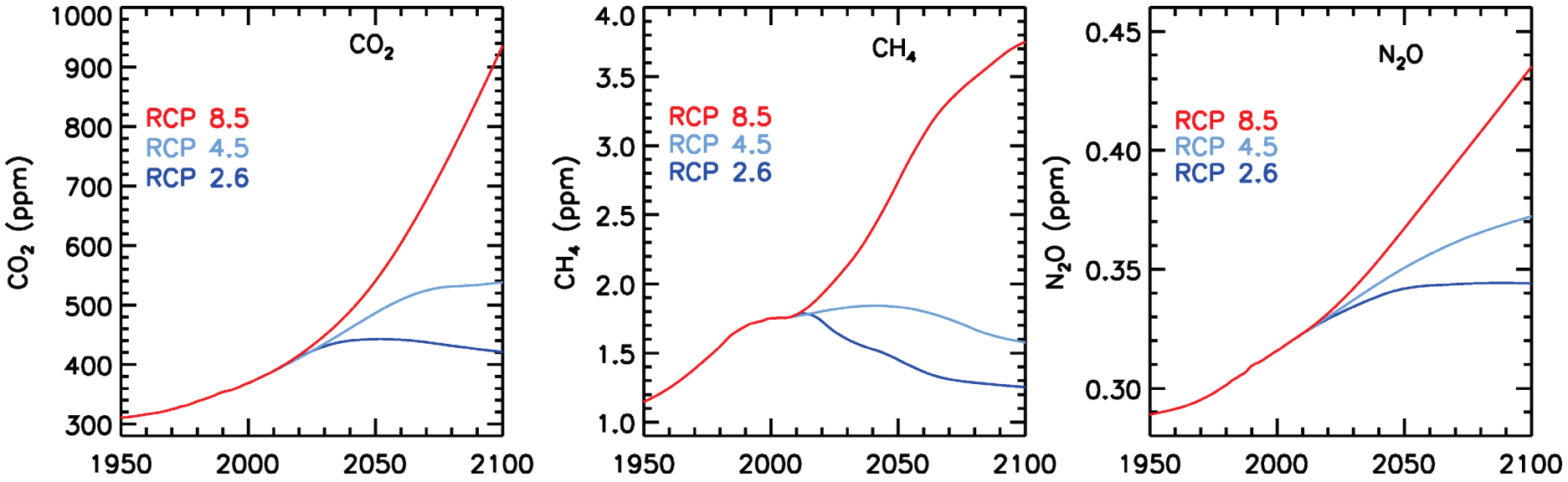
U.S. will reduce GHG emissions to 27% below 2005 level by 2025
China will peak CO_2 emissions by 2030 with best effort to peak early



https://www.wwf.org.uk/updates/our-warming-world-how-much-difference-will-half-degree-really-make

Climate Projections Are Driven by Future Levels of GHGs

- Future abundances of CO_2, CH_4, N_2O & minor GHGs provided, for use as input to climate models
- Scenarios are called Representative Concentration Pathways (RCPs); number represents increase in RF of climate (units of W m^{-2}) that will occur at end of this century



ppm ⇨ parts per million

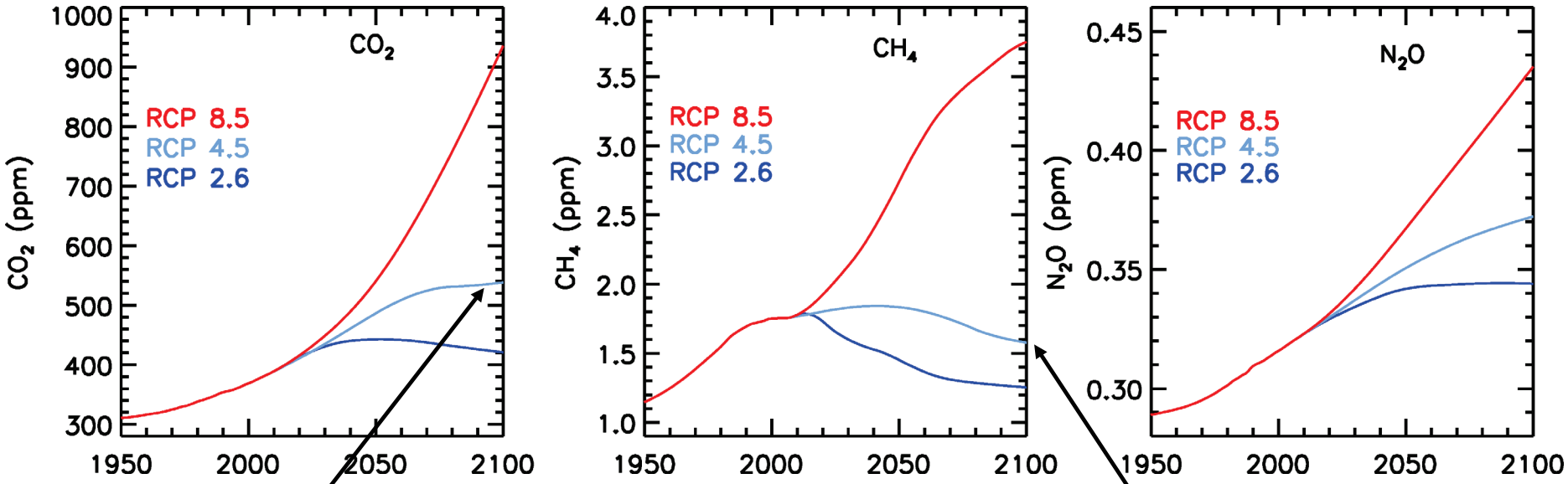
Today, CO_2 is at about 412 ppm, which means 412 out of every million molecules of air are CO_2 (rather than N_2, O_2, argon, etc)

https://www.co2.earth

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

Climate Projections Are Driven by Future Levels of GHGs

- Future abundances of CO_2, CH_4, N_2O & minor GHGs provided, for use as input to climate models
- Scenarios are called Representative Concentration Pathways (RCPs); number represents increase in RF of climate (units of W m^{-2}) that will occur at end of this century



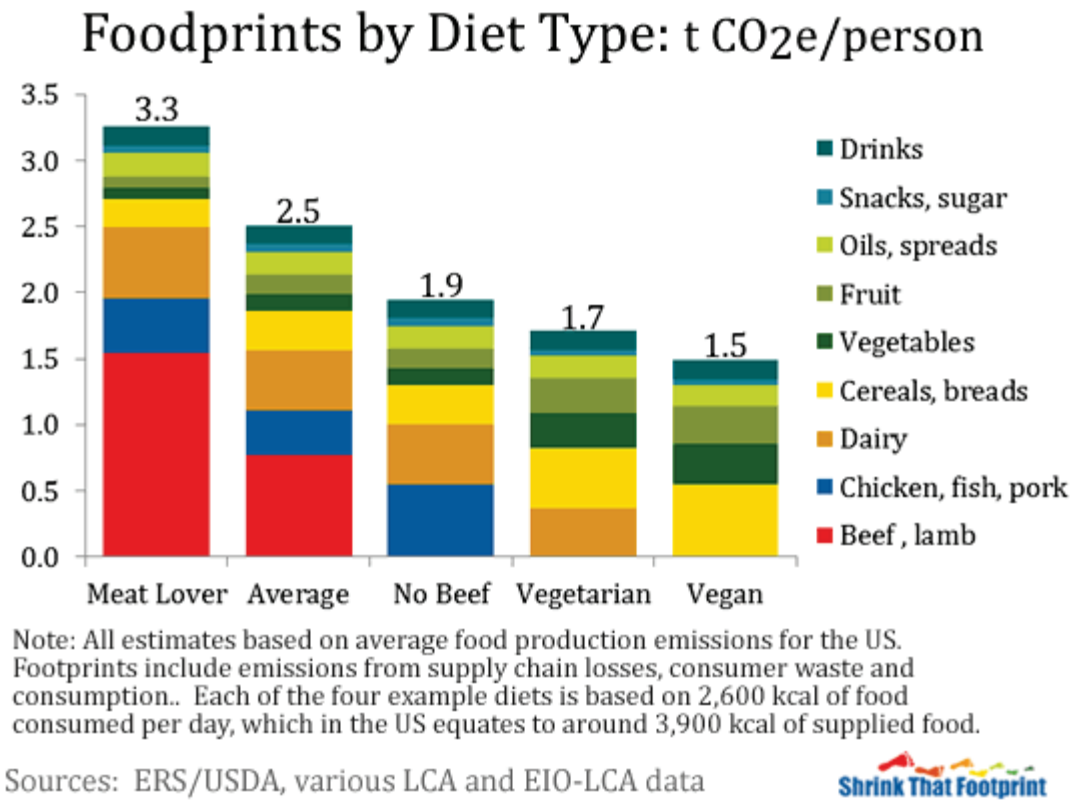
RCP 4.5: CO_2 never doubles relative to 280 ppm pre-industrial level

& CH_4 declines by end of century

A significant component of the anthropogenic release of CH_4 is from animals called ruminants that are raised for human consumption

Salawitch *et al.*, Paris Climate Agreement: Beacon of Hope, 2017.

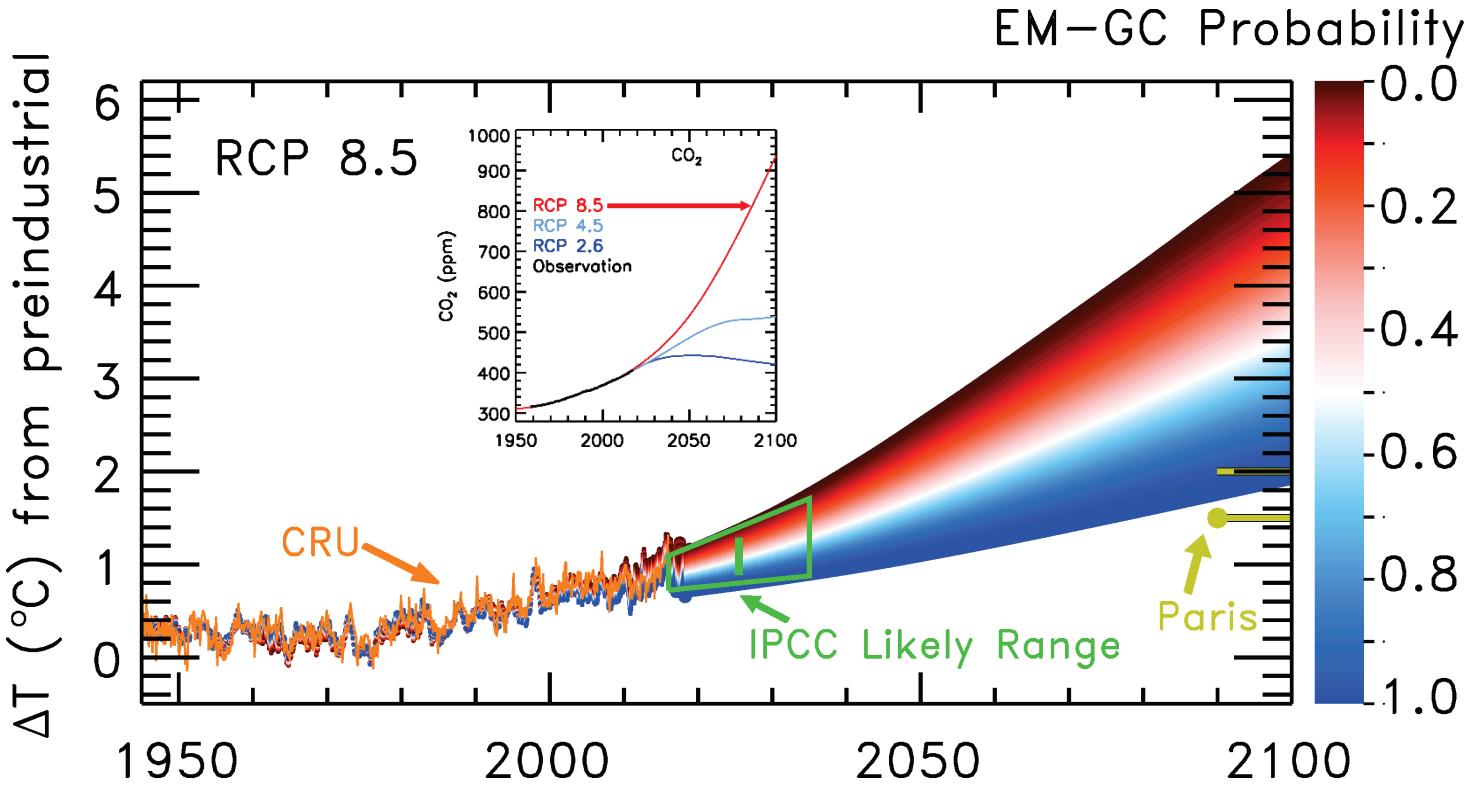
Diet Effects CO_2 Footprint
You and you alone control your diet



http://www.greeneatz.com/wp-content/uploads/2013/01/foods-carbon-footprint-7.gif

Probabilistic Forecast of *Human-Induced Rise in GMST* for model trained on data acquired until end of 2017 and future GHG levels from RCP 8.5

Fig 2.20 (updated) ***Paris Climate Agreement: Beacon of Hope***

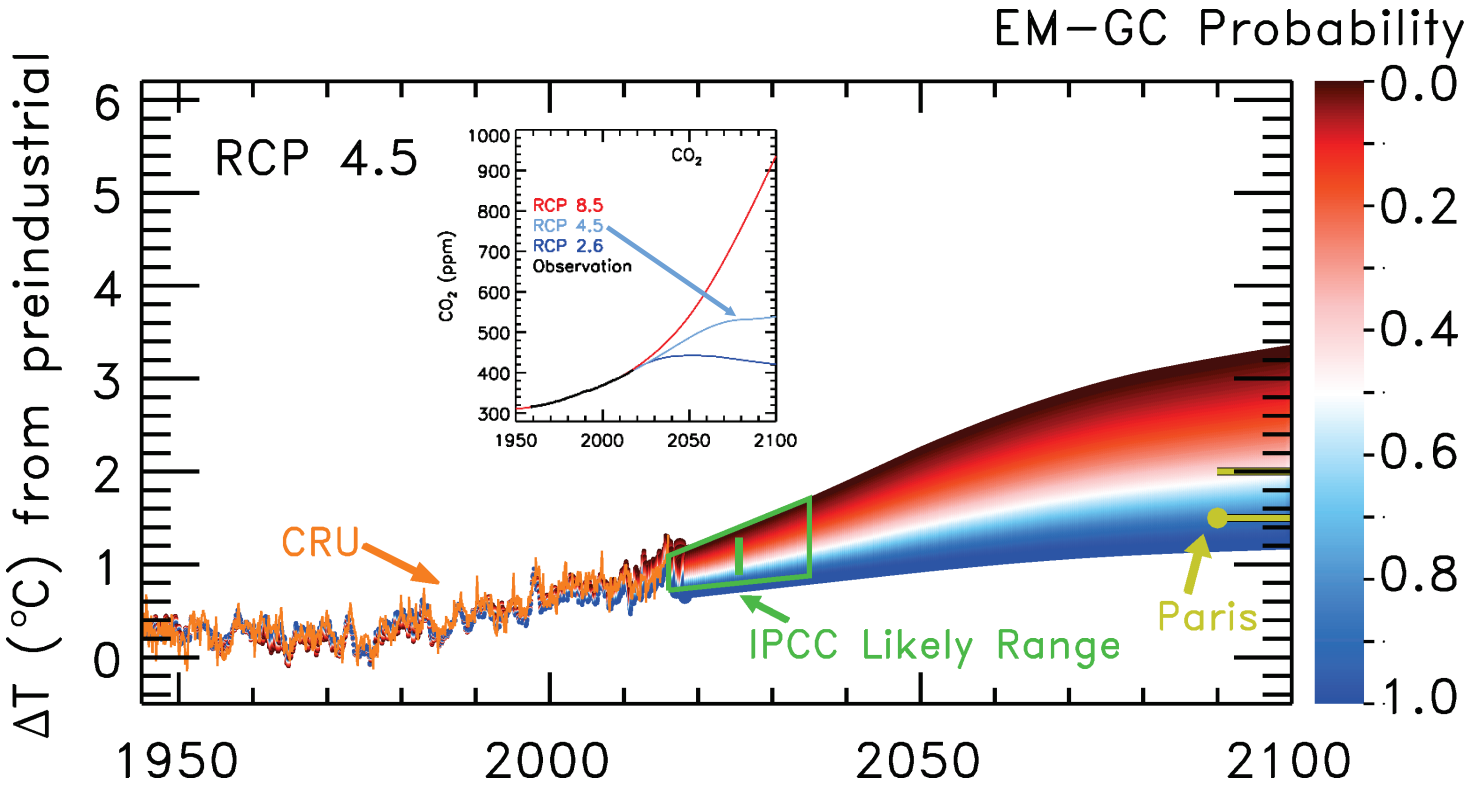


If GHGs follow RCP 8.5, **0%** chance rise GMST stays below **1.5°C** and **0.1%** chance stays below **2.0°C**

EM-GC: University of Maryland Empirical Model of Global Climate
ΔT: rise in GMST (Global Mean Surface Temperature) relative to pre-industrial
CRU: Climate Research Unit, Easy Anglia, UK: Premier source of data for ΔT
IPCC Likely Range of ΔT : From Fig 11.25b of the 2013 Intergovernmental Panel on Climate Change Report

Probabilistic Forecast of *Human-Induced Rise in GMST* for model trained on data acquired until end of 2017 and future GHG levels from RCP *4.5*

Fig 2.19 (modified) ***Paris Climate Agreement: Beacon of Hope***

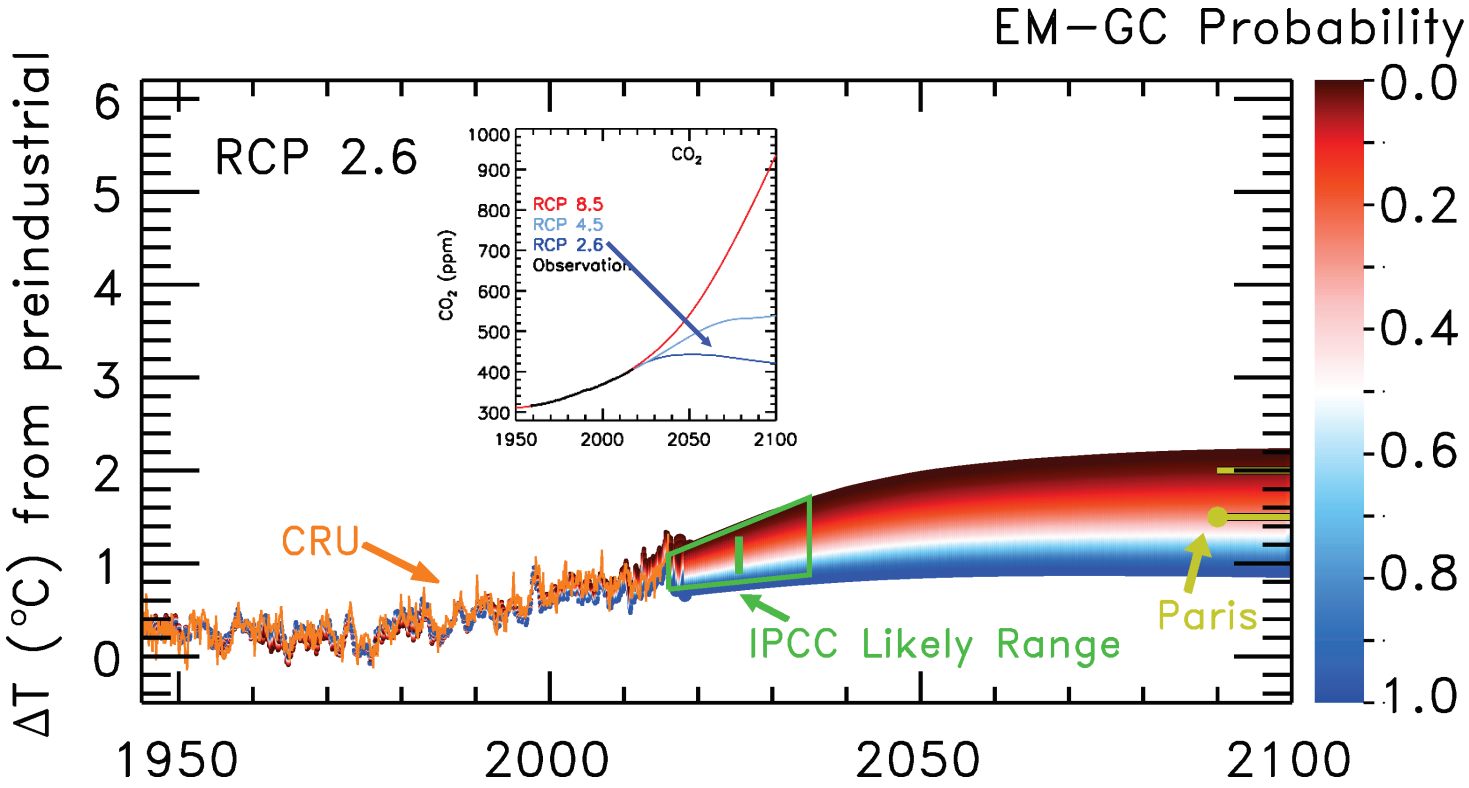


If GHGs follow RCP 4.5, **9%** chance rise GMST stays below **1.5°C** and **51%** chance stays below **2.0°C**

EM-GC: University of Maryland Empirical Model of Global Climate
ΔT: rise in GMST (Global Mean Surface Temperature) relative to pre-industrial
CRU: Climate Research Unit, Easy Anglia, UK: Premier source of data for ΔT
IPCC Likely Range of ΔT : From Fig 11.25b of the 2013 Intergovernmental Panel on Climate Change Report

Probabilistic Forecast of *Human-Induced Rise in GMST* for model trained on data acquired until end of 2017 and future GHG levels from RCP *2.6*

Fig 2.19 (modified) ***Paris Climate Agreement: Beacon of Hope***



If GHGs follow RCP 2.6, **68%** chance rise GMST stays below **1.5°C** and **96%** chance stays below **2.0°C**

EM-GC: University of Maryland Empirical Model of Global Climate
ΔT: rise in GMST (Global Mean Surface Temperature) relative to pre-industrial
CRU: Climate Research Unit, Easy Anglia, UK: Premier source of data for ΔT
IPCC Likely Range of ΔT : From Fig 11.25b of the 2013 Intergovernmental Panel on Climate Change Report

GHG Emission Projection

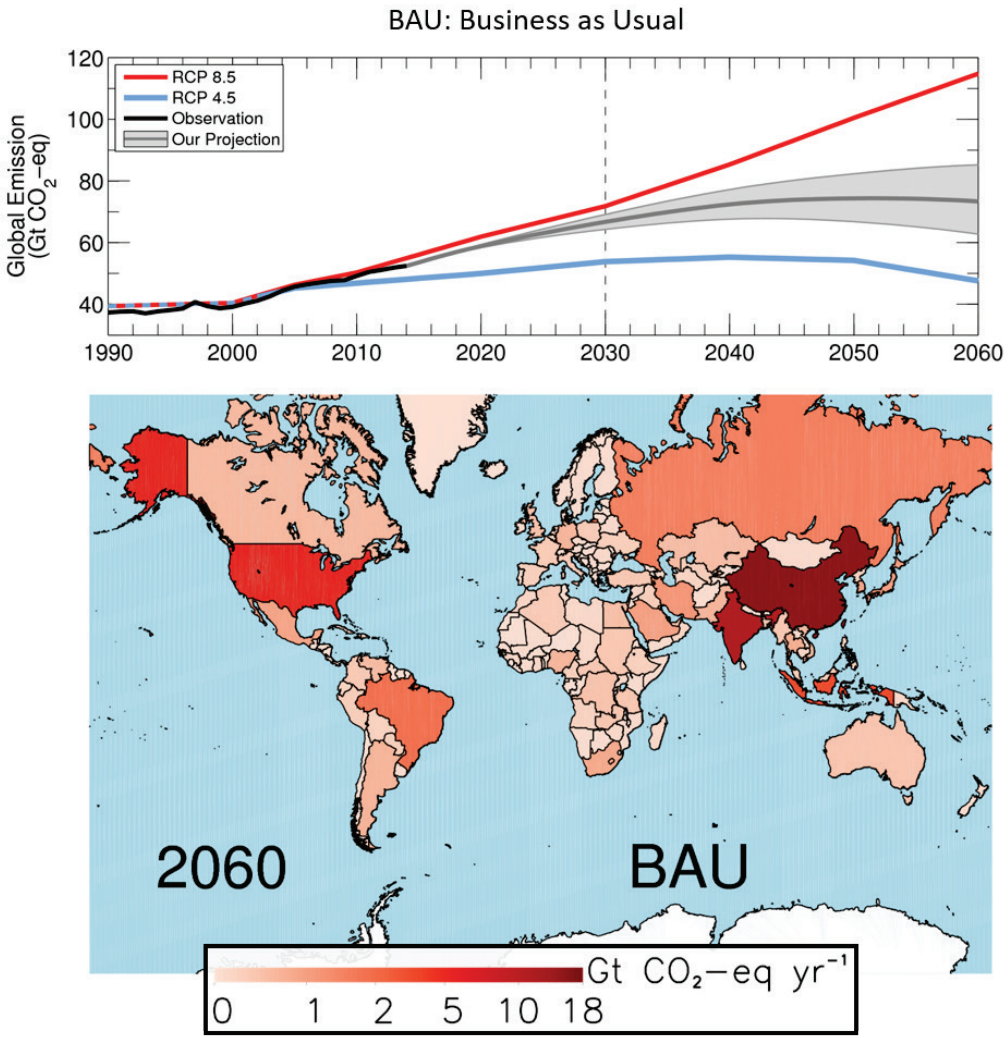


Fig. 3.8 & 3.13

CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

RCP 4.5 & 8.5: GHG scenarios with 2.6., 4.5, and 8.5 W m^{-2} RF of climate in 2100
Uncertainty in "Our Projection" due to various population projections

GHG Emission Projection

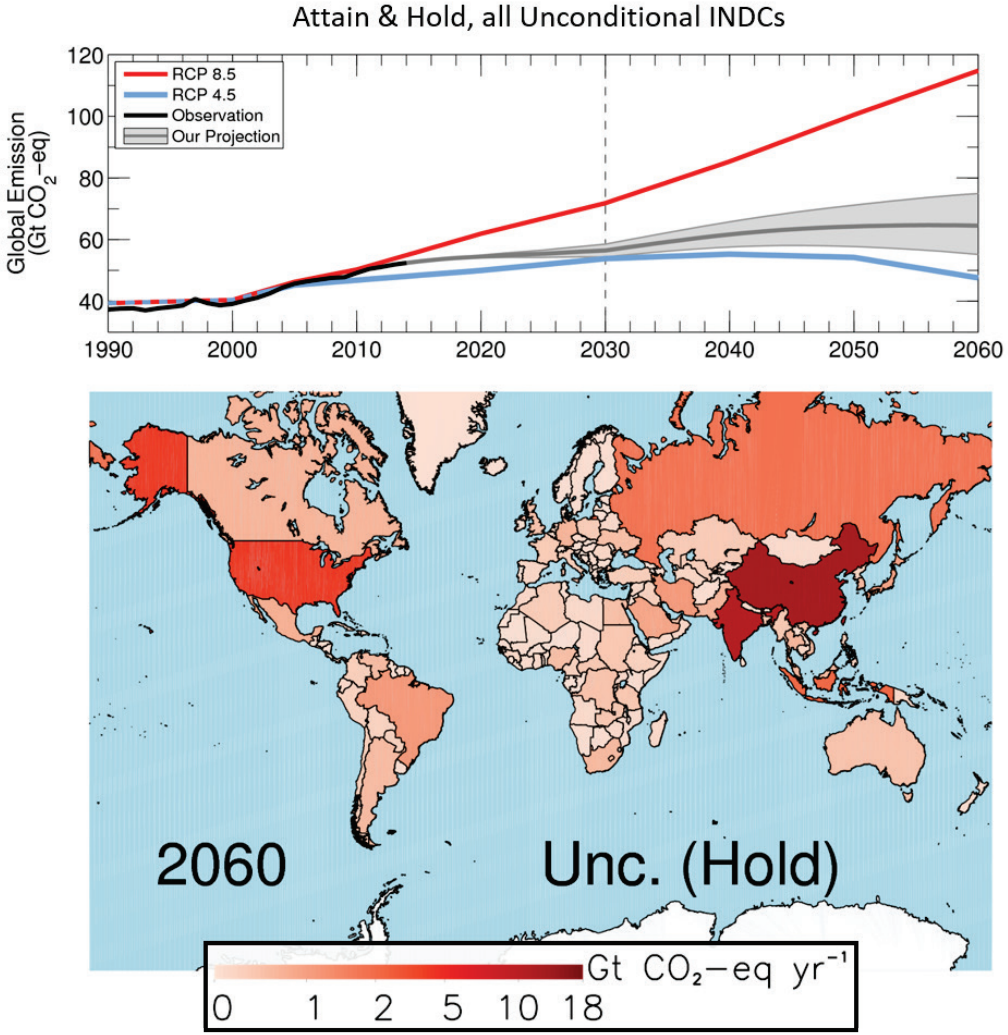


Fig. 3.9 & 3.13

CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

INDC: Intended Nationally Determined Contribution (to reduce emissions of GHGs)

Unconditional: We promise, no matter what, to follow our INDC

GHG Emission Projection

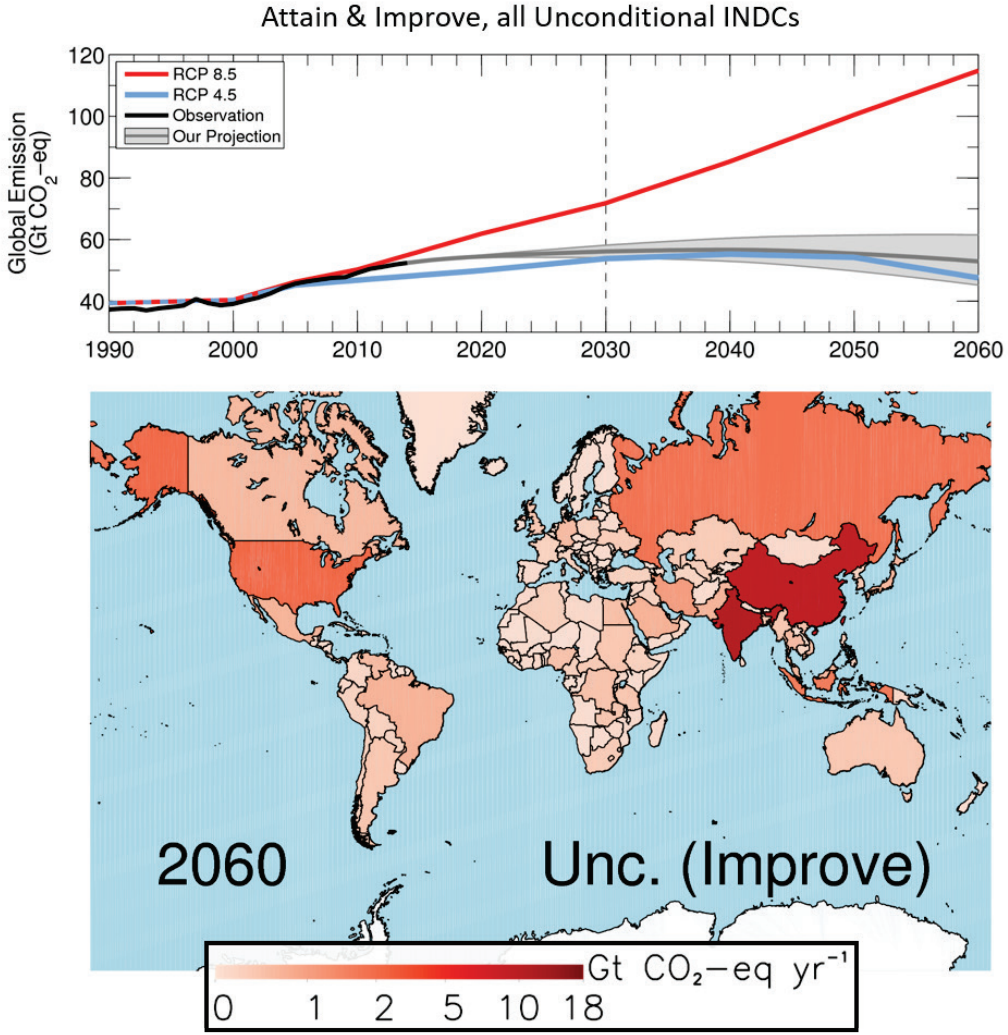


Fig. 3.10 & 3.13

CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

INDC: Intended Nationally Determined Contribution (to reduce emission of GHGs)

Unconditional: We promise, no matter what, to follow our INDC and keep ***improving the carbon efficiency of our economy***

GHG Emission Projection

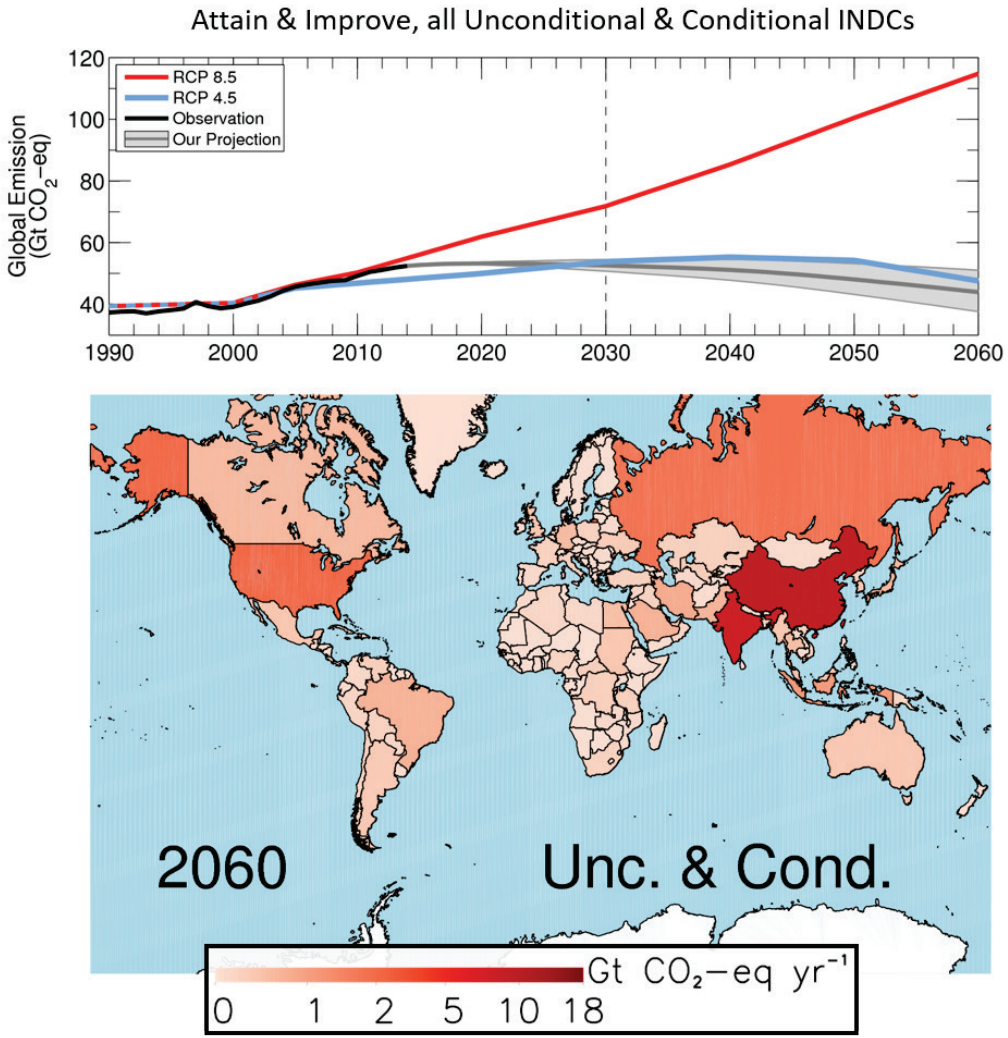


Fig. 3.11 & 3.13

CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

INDC: Intended Nationally Determined Contribution (to reduce emission of GHGs)

Unconditional: We promise, no matter what, to follow our INDC and keep ***improving the carbon efficiency of our economy***

Conditional: GHG reductions contingent on financial and/or technology transfer

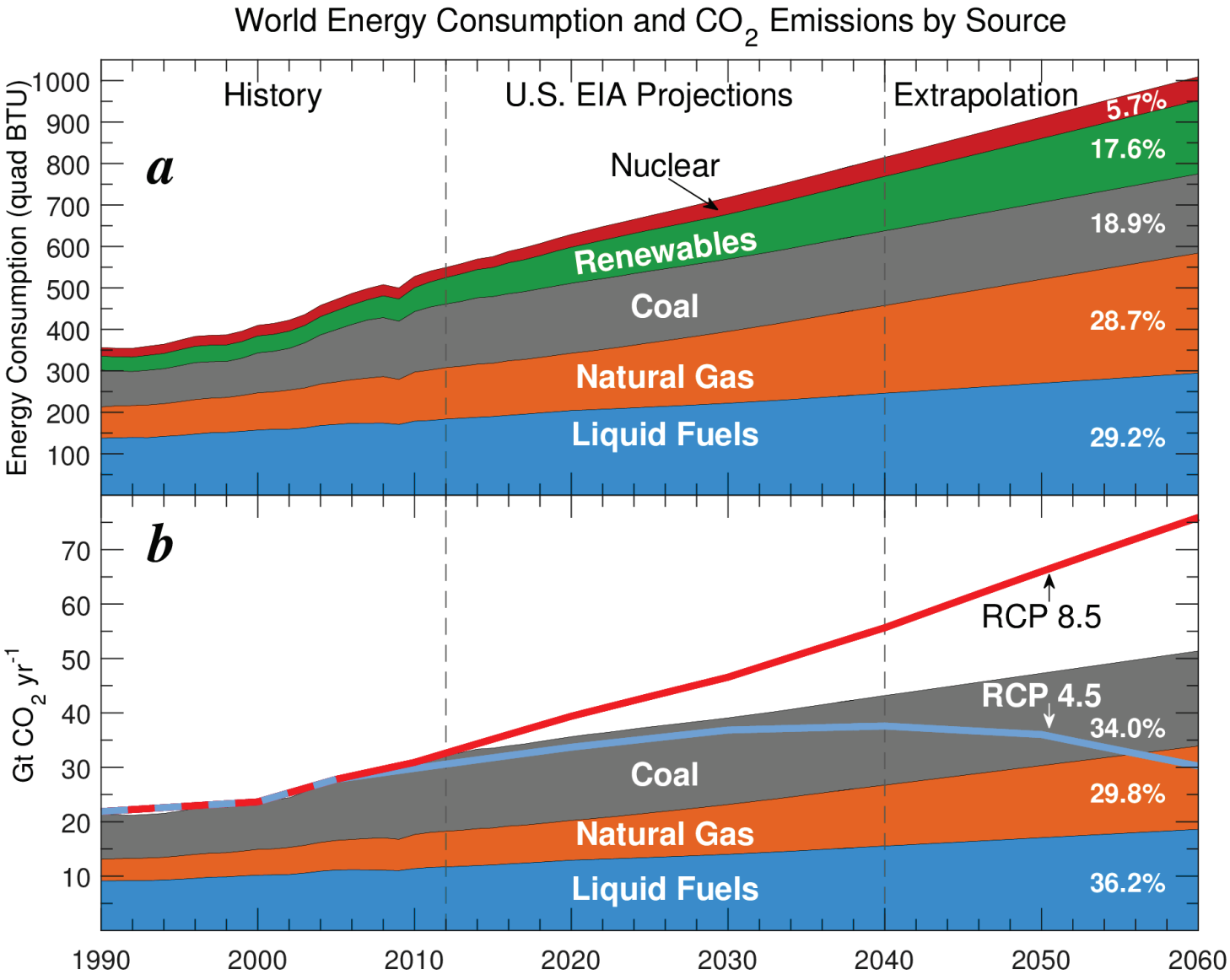


Fig. 4.2

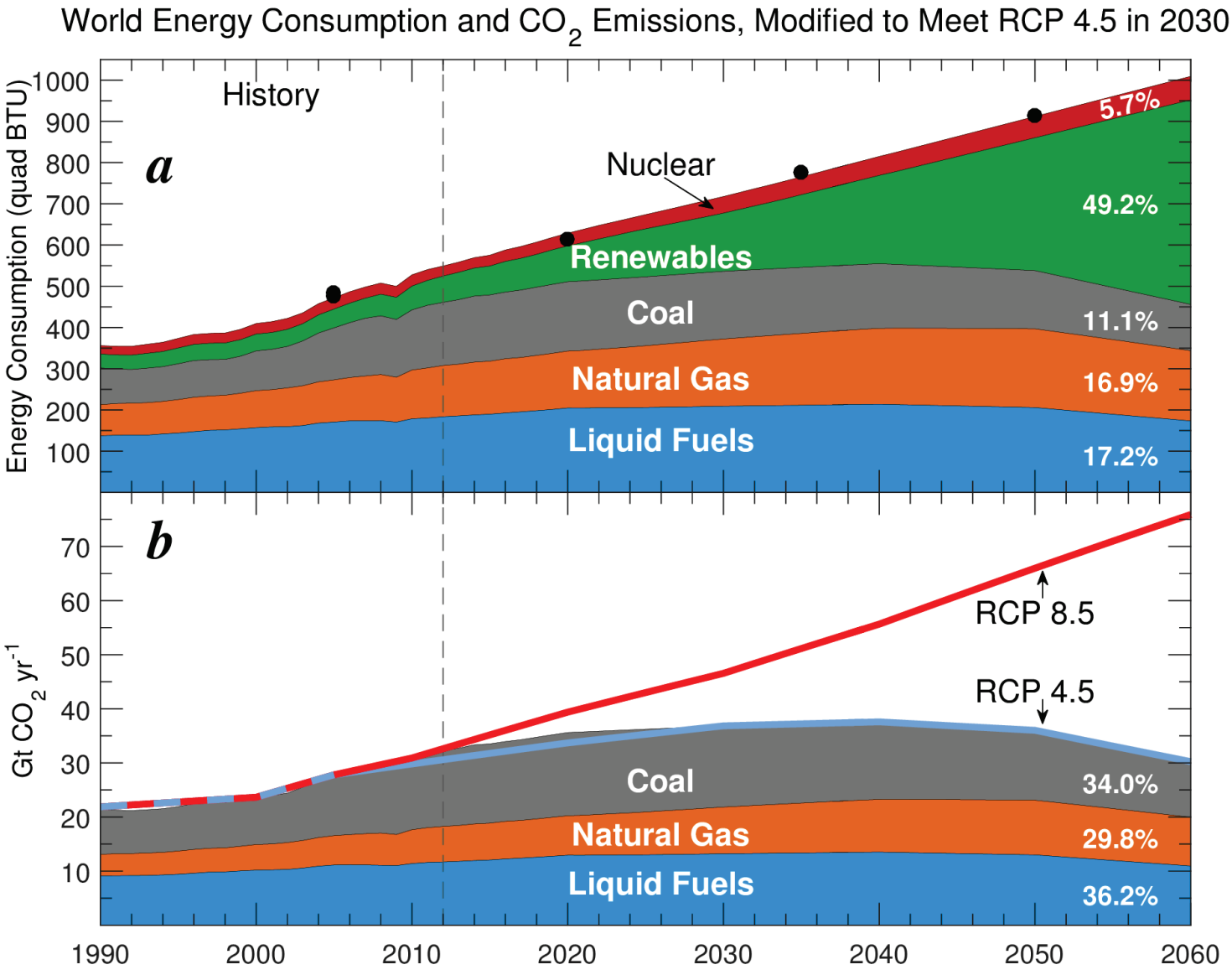


Fig. 4.3

Achieving RCP 4.5 requires *half of world energy* to be supplied by sources that do not emit GHGs, by year 2060

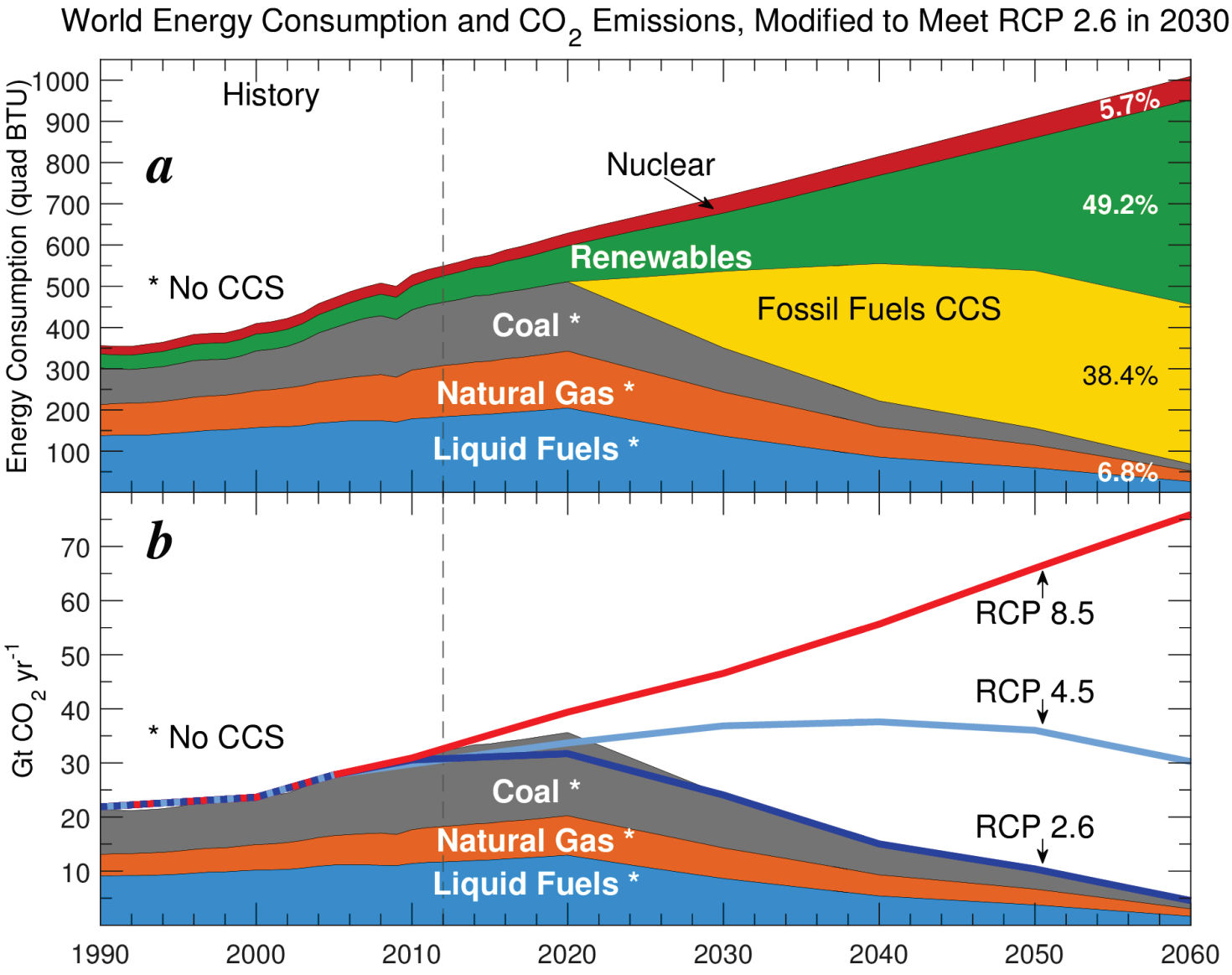
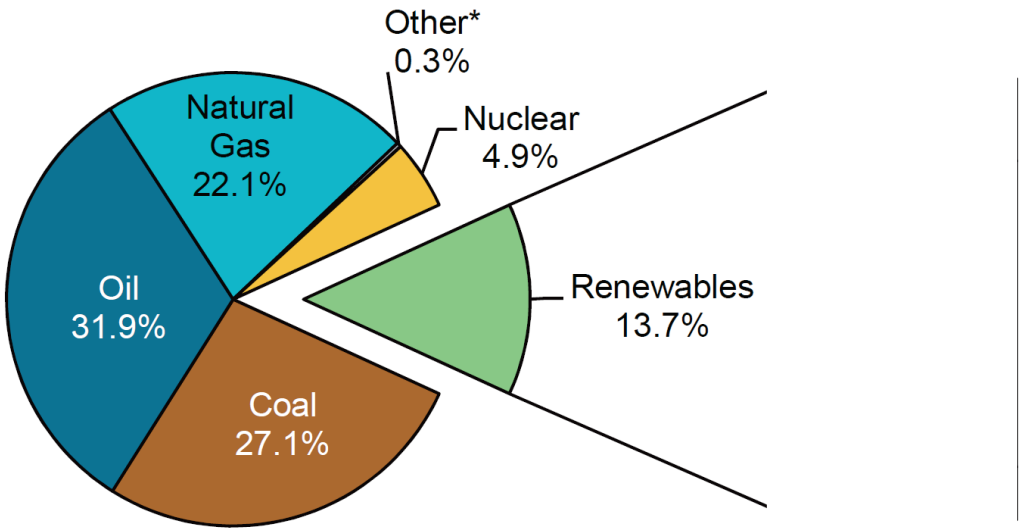


Fig. 4.3

Achieving RCP 2.6 requires *90% of world energy* to be supplied by sources that do not emit GHGs, by year 2060

World Energy Supply, 2016

Figure 1: 2016 fuel shares in world total primary energy supply

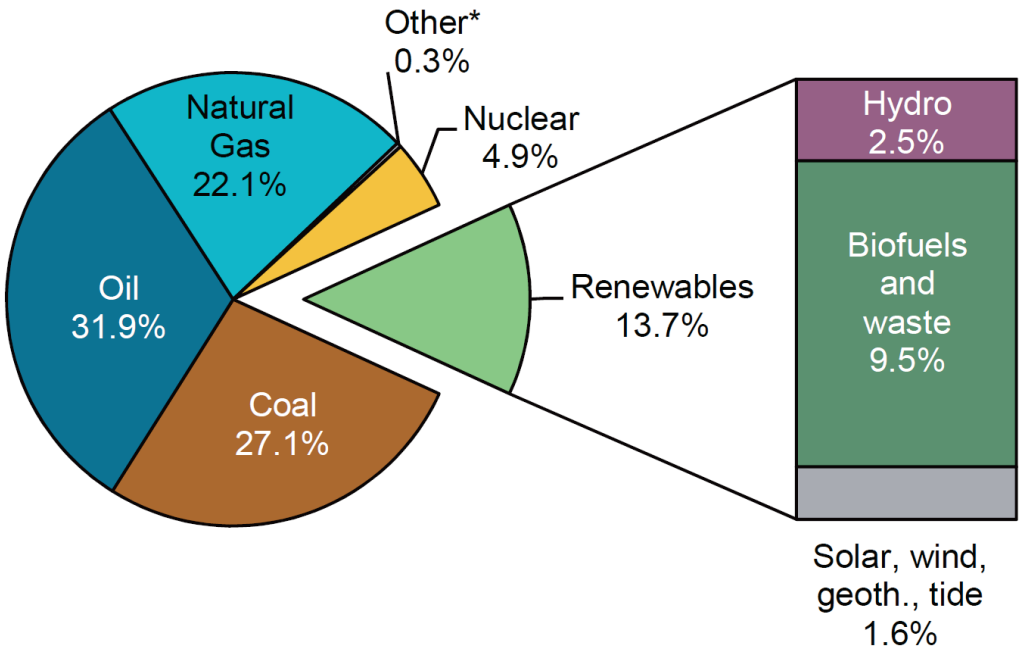


In 2016, world obtained ~19% of its **energy** from sources that do not release prodigious GHGs

https://webstore.iea.org/download/direct/2260?fileName=Renewables_Information_2018_Overview.pdf

World Energy Supply, 2016

Figure 1: 2016 fuel shares in world total primary energy supply

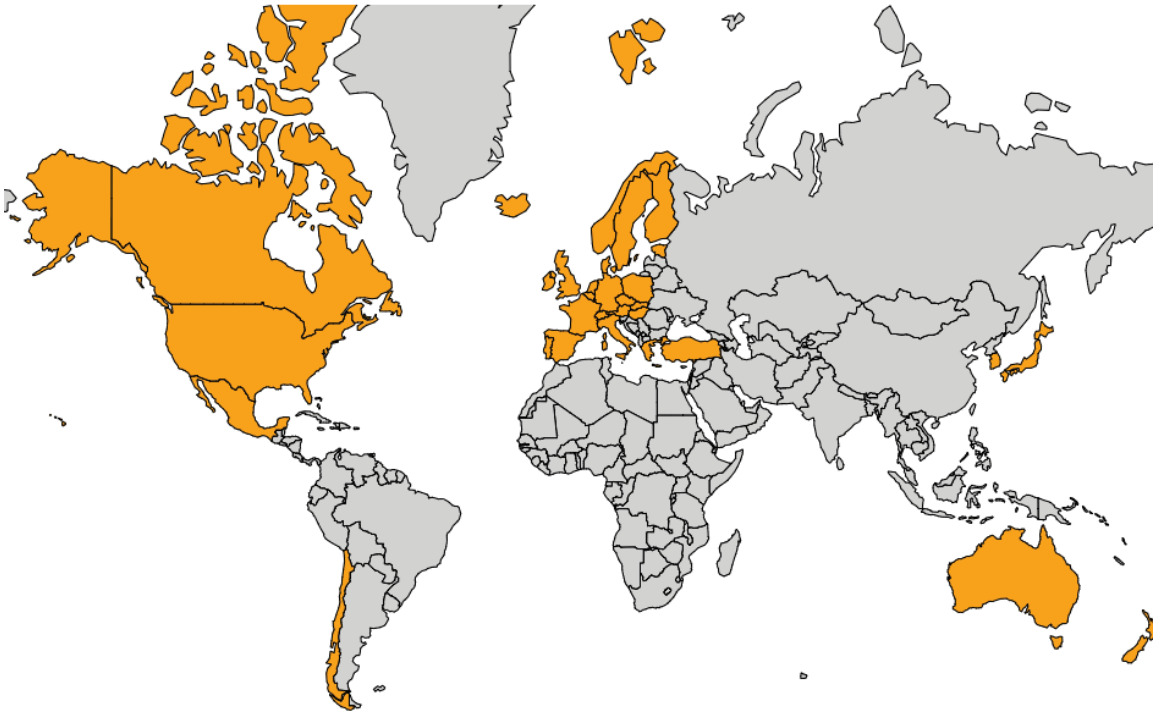


In 2016, world obtained ~19% of its **energy** from sources that do not release prodigious GHGs

https://webstore.iea.org/download/direct/2260?fileName=Renewables_Information_2018_Overview.pdf

If the world obtained ~19% of its energy from sources that do not release prodigious GHGs in 2016, what percentage was obtained by OECD nations?

OECD: Organization for Economic Co-operation and Development

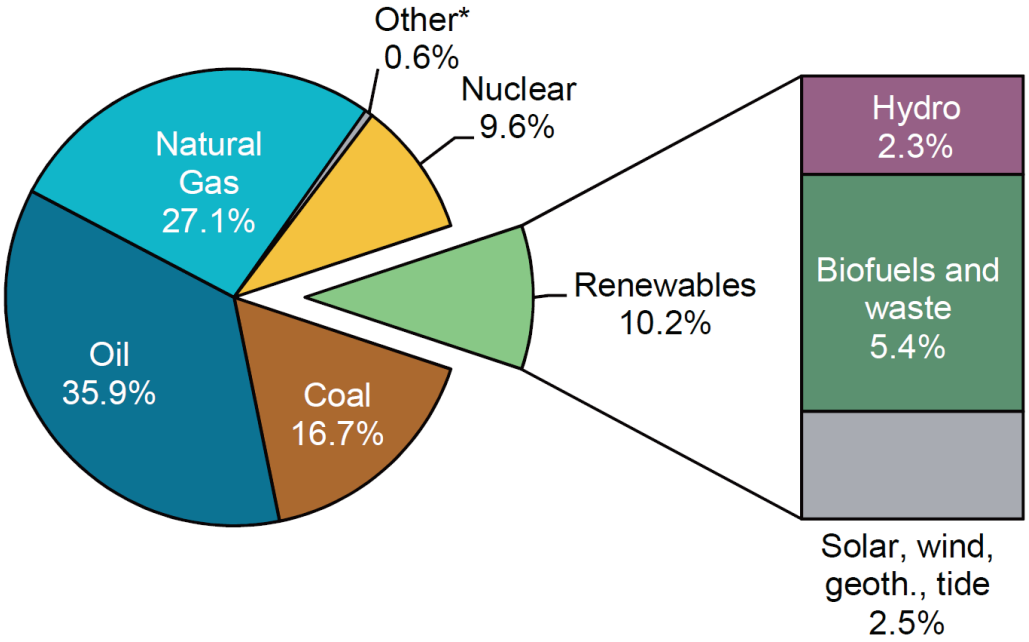


- Australia
- Austria
- Belgium
- Canada
- Chile
- The Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Israel
- Italy
- Japan
- Korea
- Latvia
- Lithuania
- Luxembourg
- Mexico
- The Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- The Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- The United Kingdom
- The United States of America

http://worldpopulationreview.com/countries/oecd-countries/

OECD Energy Supply, 2017

Figure 8: 2017 fuel shares in OECD total primary energy supply

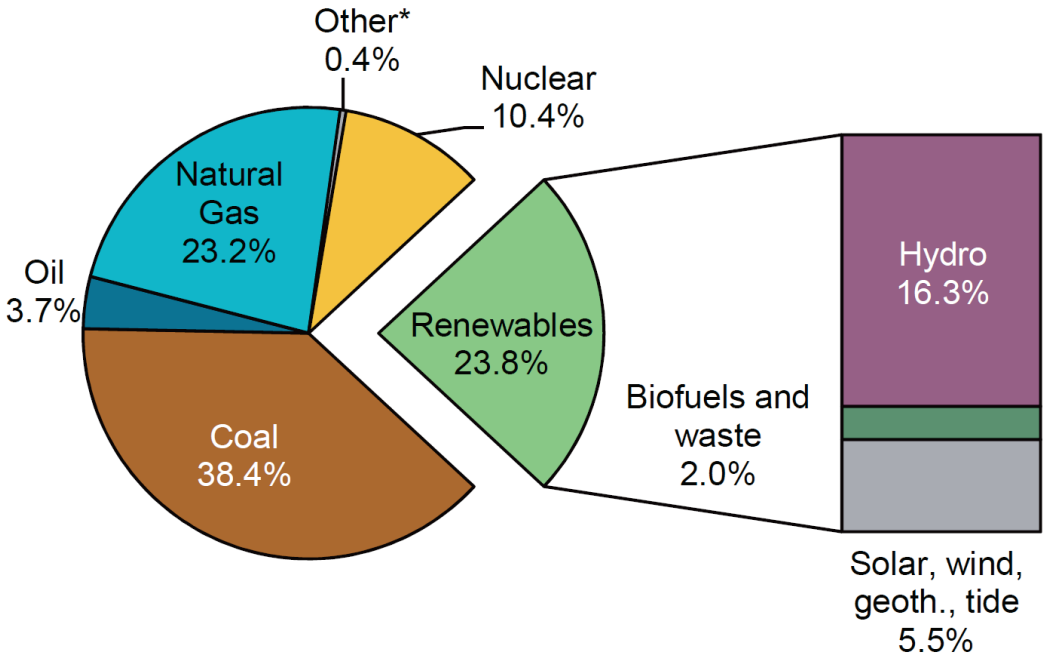


In 2017, OECD obtained ~20% of its **energy** from sources that do not release prodigious GHGs

https://webstore.iea.org/download/direct/2260?fileName=Renewables_Information_2018_Overview.pdf

World Electricity Supply, 2016

Figure 7: Fuel shares in world electricity production in 2016

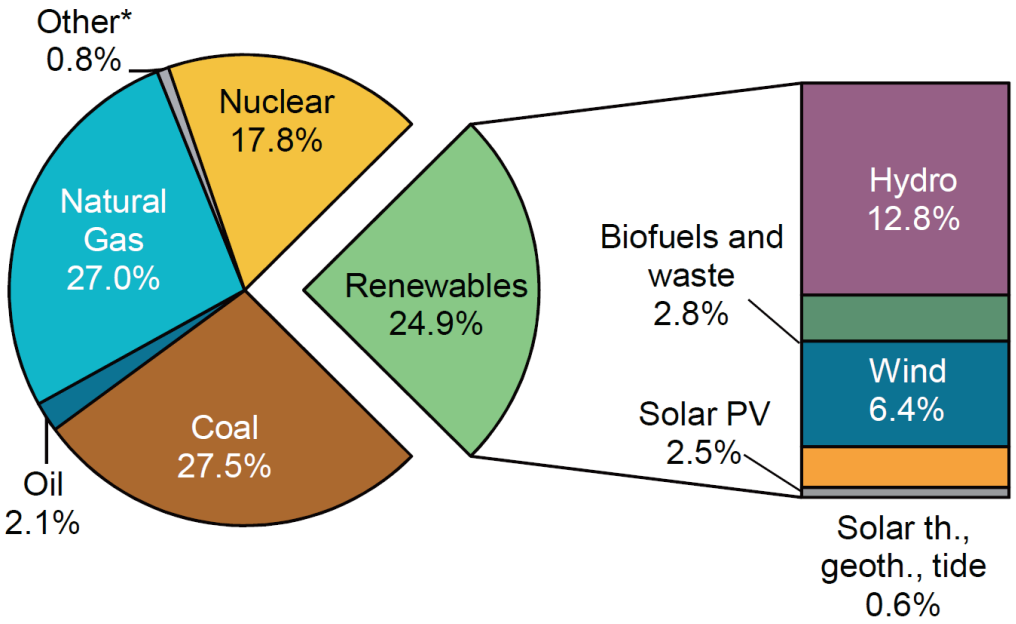


In 2016, world obtained ~34% of its **electricity** from sources that do not release prodigious GHGs

https://webstore.iea.org/download/direct/2260?fileName=Renewables_Information_2018_Overview.pdf

OECD Electricity Supply, 2017

Figure 14: Renewable shares in OECD electricity production in 2017



In 2016, OECD obtained ~43% of its **electricity** from sources that do not release prodigious GHGs

https://webstore.iea.org/download/direct/2260?fileName=Renewables_Information_2018_Overview.pdf

Paris Climate Agreement, Dec 2015:

a) Negotiated as an "agreement" unilateral pledges to reduce GHG emissions by by member nations) rather than a treaty to avoid the need for Senate approval

https://www.senate.gov/artandhistory/history/common/briefing/Treaties.htm

b) US committed to agreement until 5 November 2020, based on language of ratification

https://qz.com/996882/paris-climate-agreement-trumps-renegotiation-is-not-realistic-in-any-way/

Summer 2017:

President Trump states US intends to withdraw from Paris Climate Agreement

- "withdrawal" symbolic in that US is committed to the agreement until ***5 Nov 2020***

http://www.politico.com/story/2017/08/04/trump-notice-withdraw-from-paris-climate-deal-241331

August 2018:

- Obama's plan for achieving the US INDC had relied on implementation of the Clean Power Plan by the EPA
- Main gist of Clean Power Plan was transitioning power plants from coal to either natural gas or renewables
- Combustion of natural gas produces about 70% more energy per CO_2 released to the atmosphere than coal
- Clean power plan being abandoned by the US EPA

https://psmag.com/environment/the-epa-publishes-its-proposed-replacement-for-the-clean-power-plan

but the main reason natural gas has replaced coal for US power generation is economic rather than regulatory

What will happen on 4 Nov 2020 ?

GHG Emission Projection

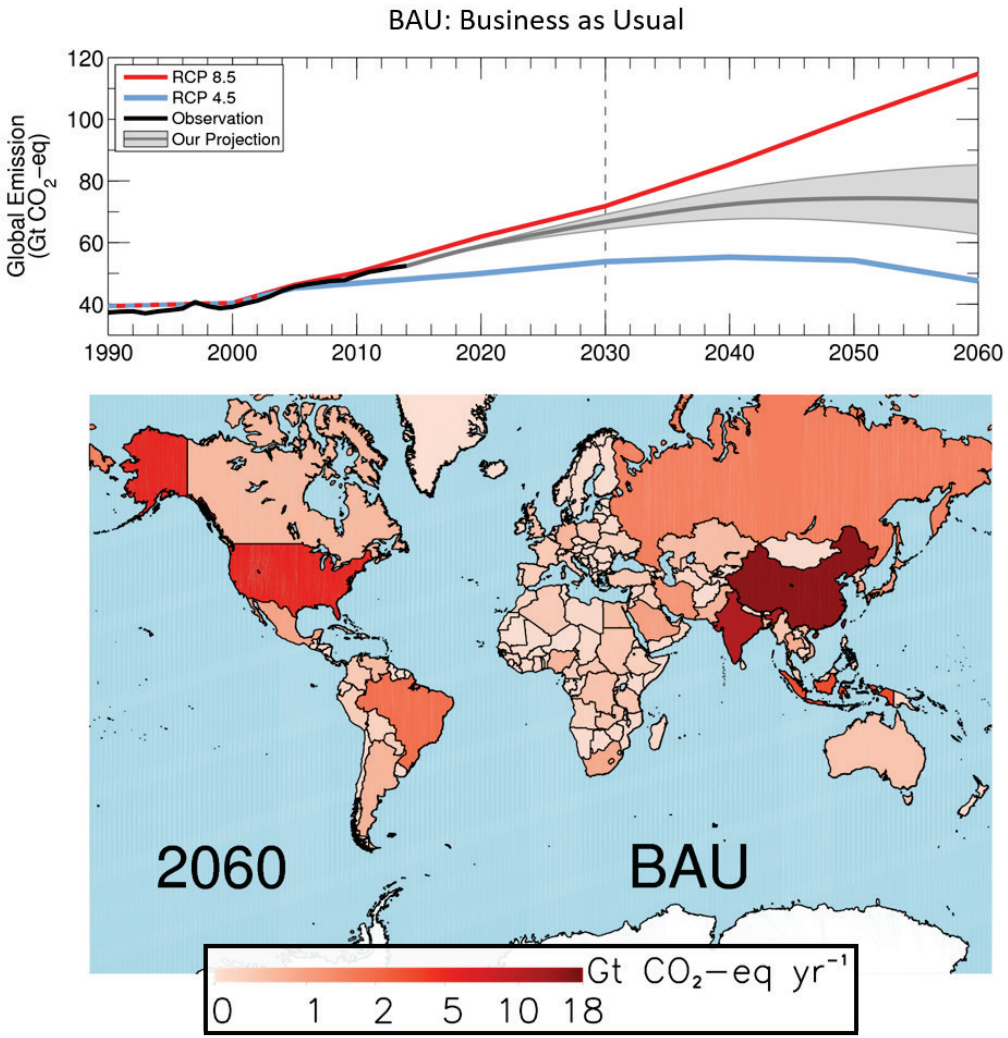


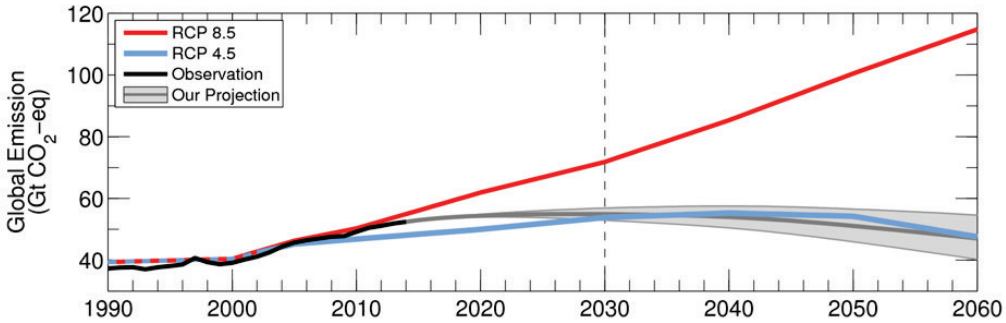
Fig. 3.8 & 3.13

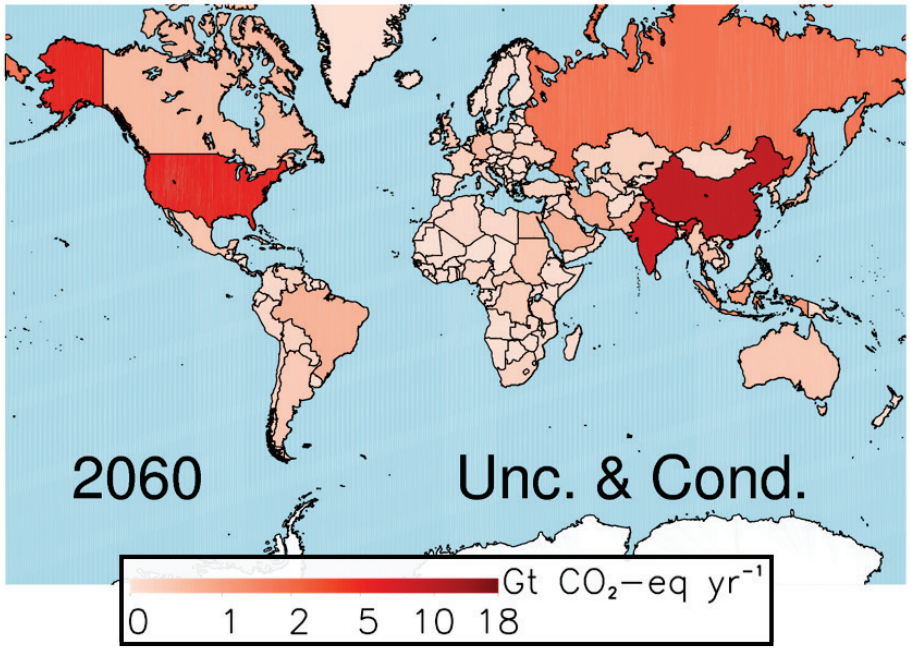
CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

RCP 4.5 & 8.5: GHG scenarios with 2.6., 4.5, and 8.5 W m^{-2} RF of climate in 2100
Uncertainty in "Our Projection" due to various population projections

Attain & Improve, all Unconditional & Conditional INDCs

Except US BAU





New Work

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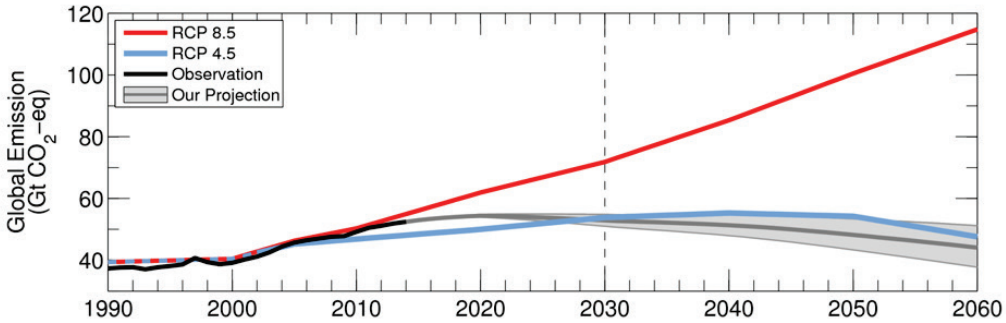
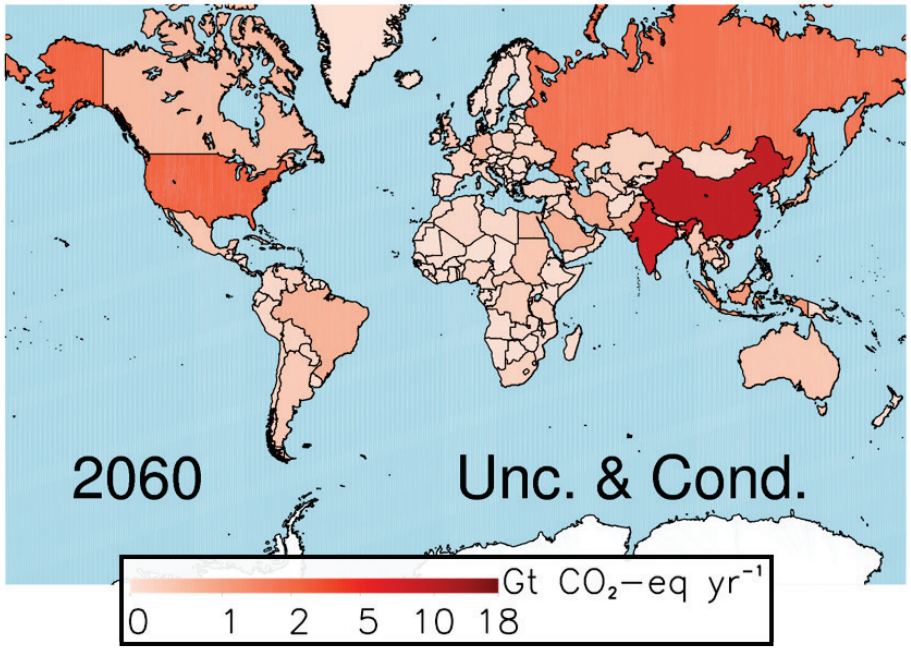
Attain & Improve, all Unconditional & Conditional INDCs

Except US 4 year delay





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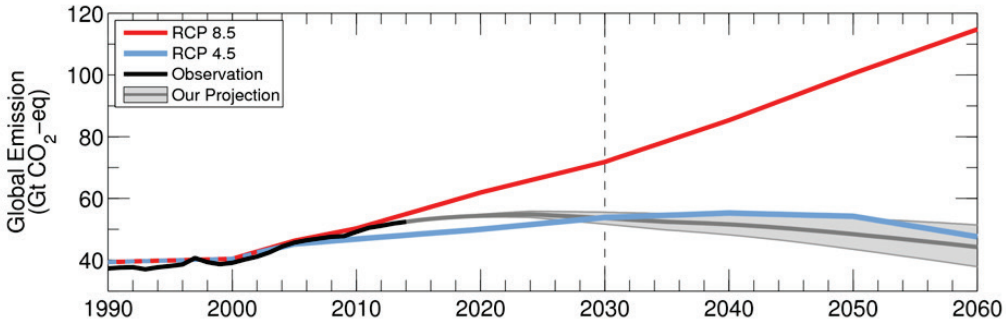

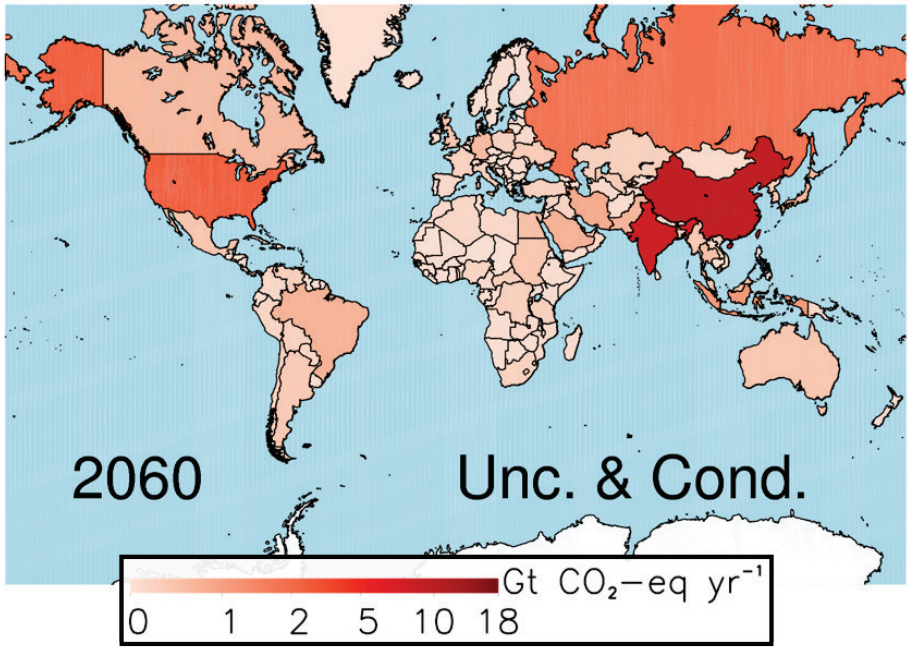

New Work

CO_2-eq: Considers emissions of CO_2, CH_4, & N_2O

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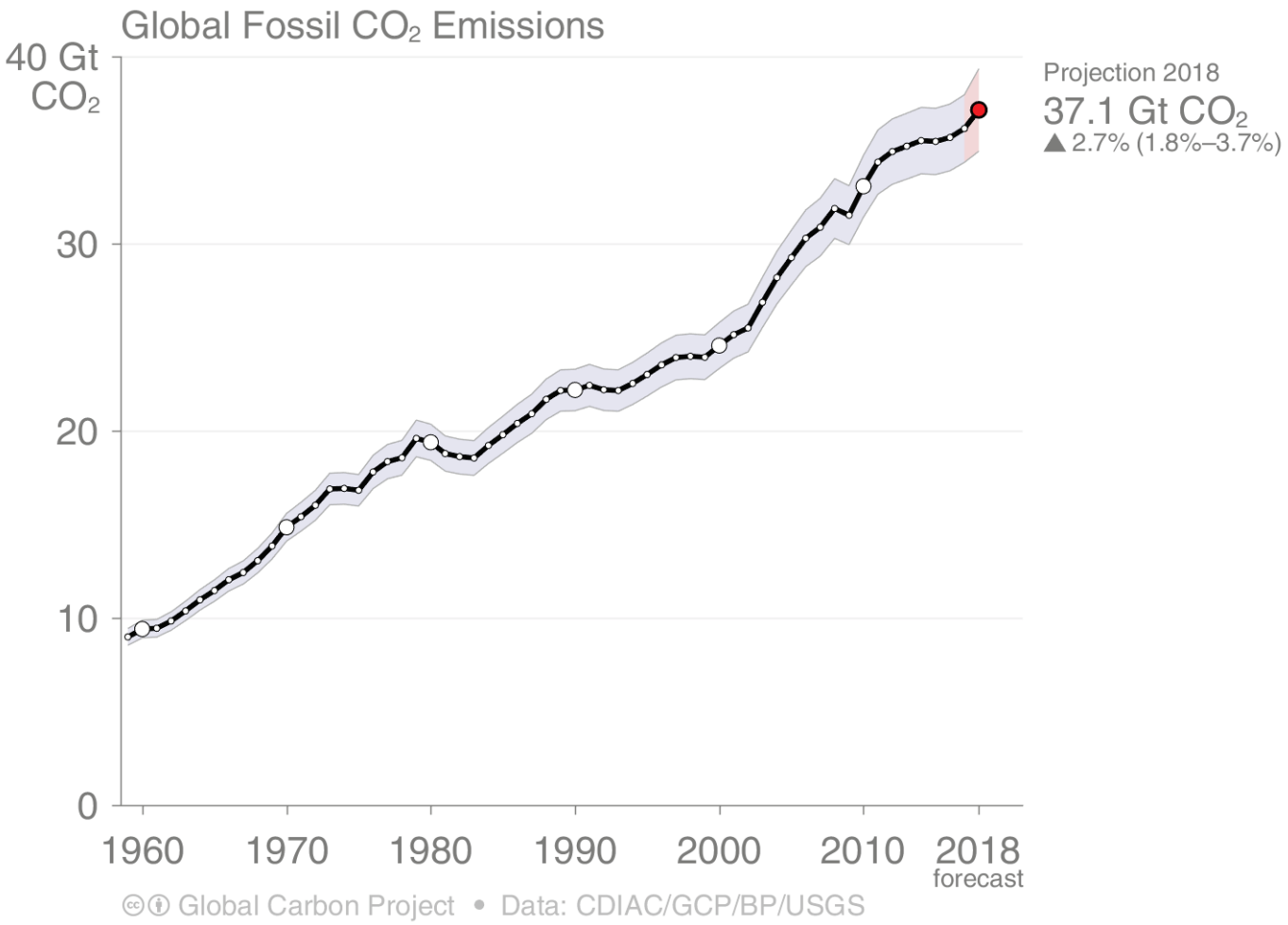
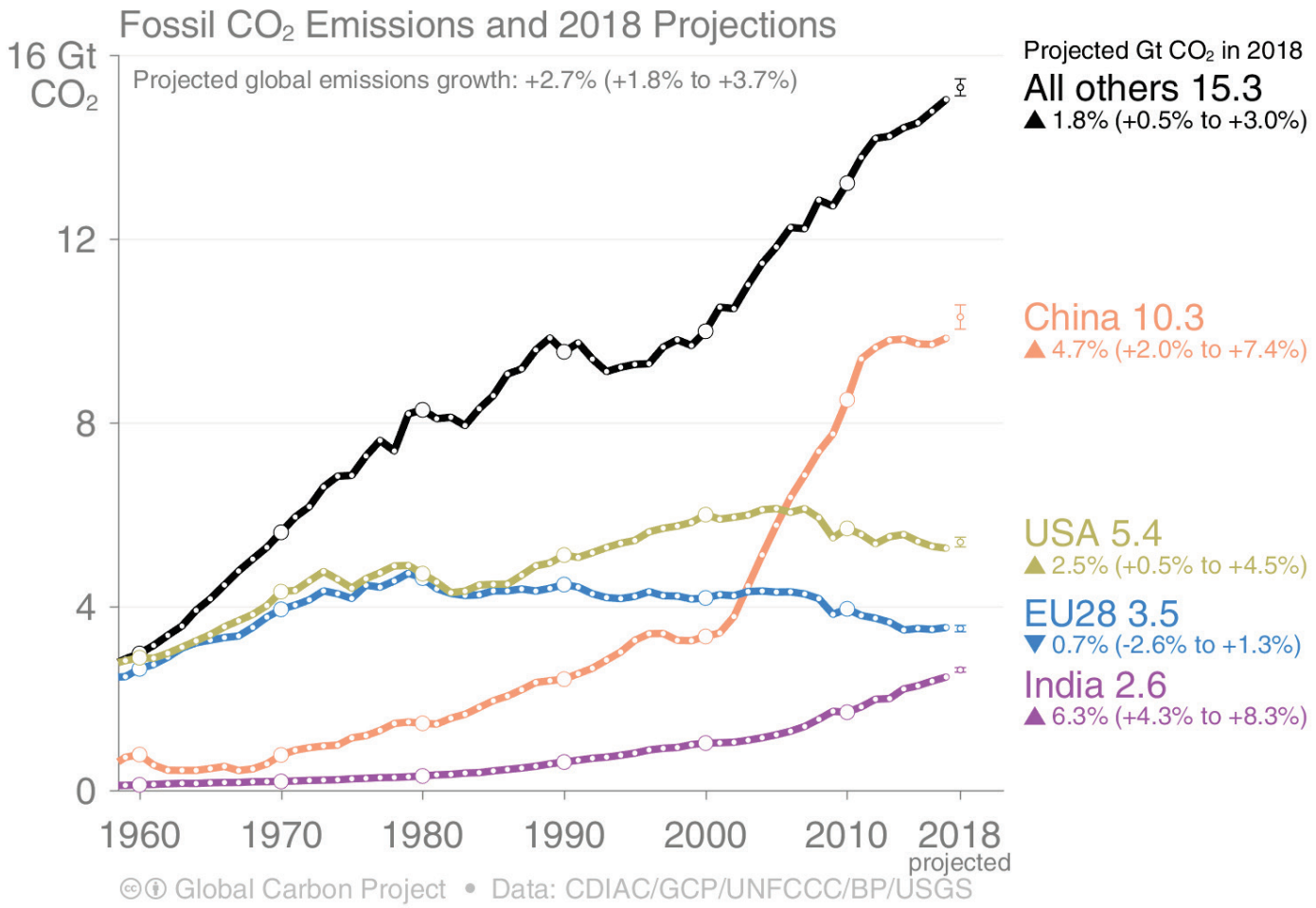
Global GHG emissions reached all time high in 2018



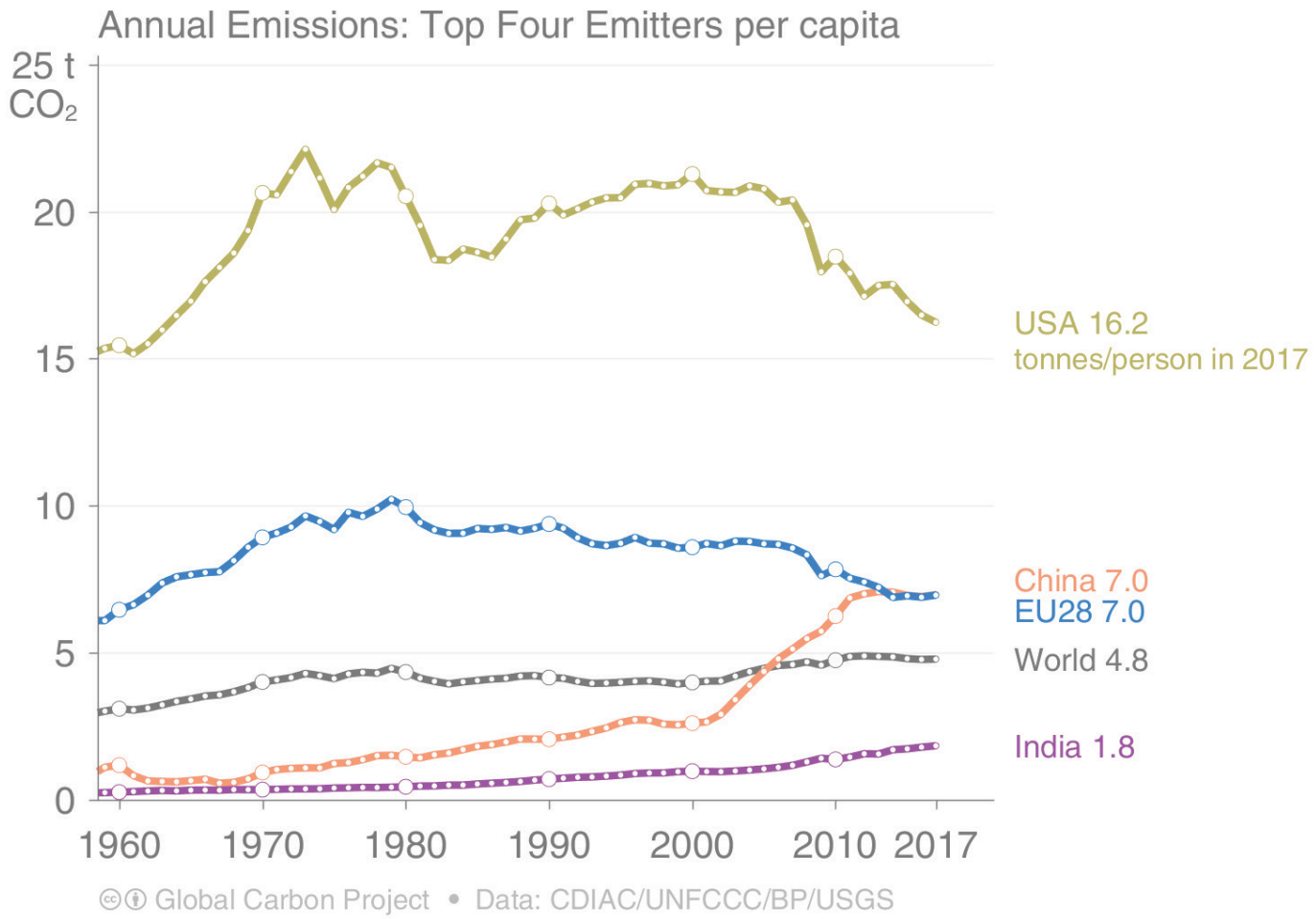
The Global Carbon Project
https://www.globalcarbonproject.org/carbonbudget/18/files/GCP_CarbonBudget_2018.pptx

China became the largest emitter of CO_2 more than a decade ago



The Global Carbon Project
https://www.globalcarbonproject.org/carbonbudget/18/files/GCP_CarbonBudget_2018.pptx

The range of per capita, or per person, emission of CO_2 is vast



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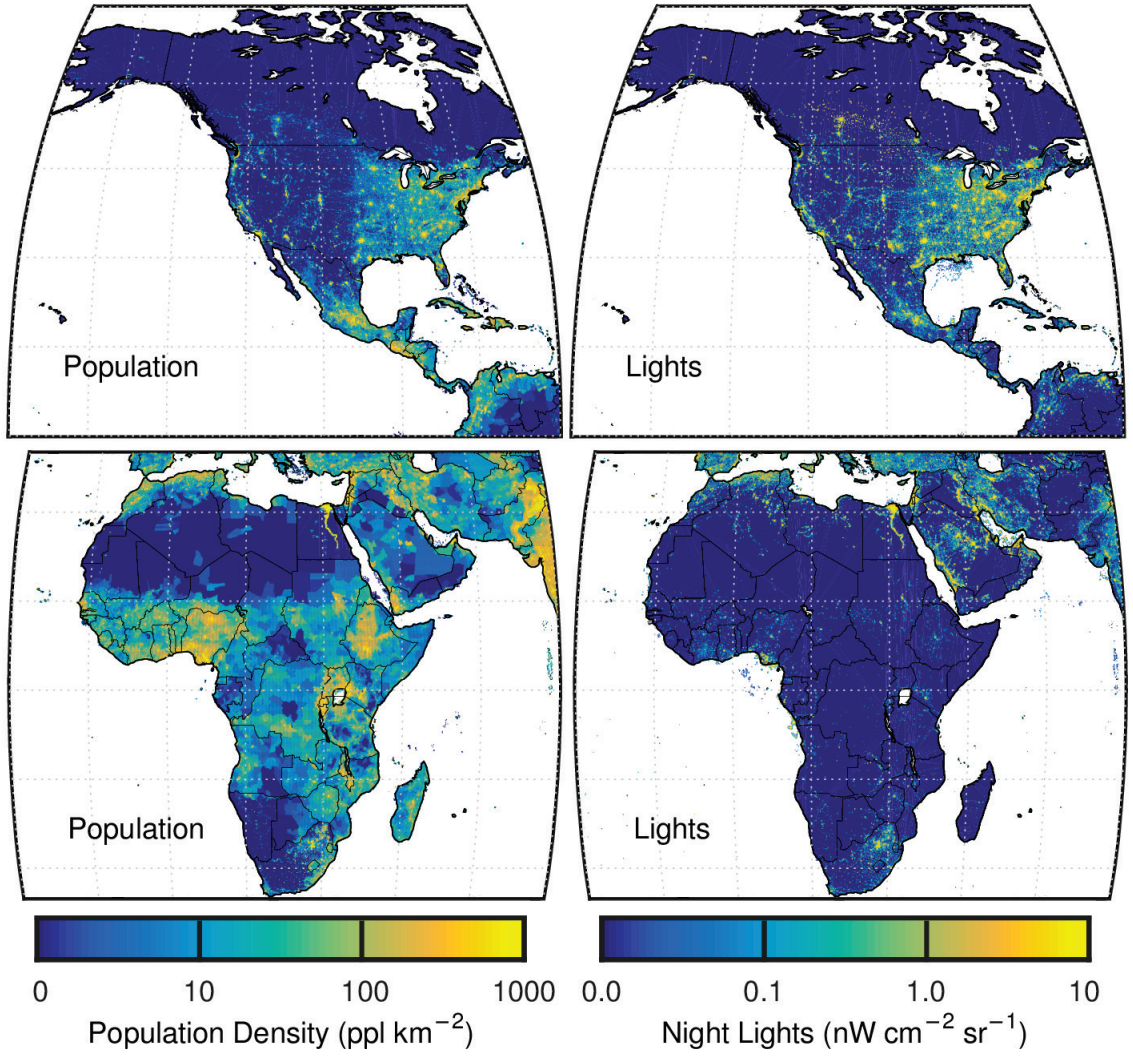

Fig 4.7
Paris Climate Agreement: Beacon of Hope

Limiting global warming to 2°C will require a massive transition to renewables and/or implementation of carbon capture and sequestration in the developed world and initial electrification of developing world by renewables (i.e., must bypass fossil fuels)

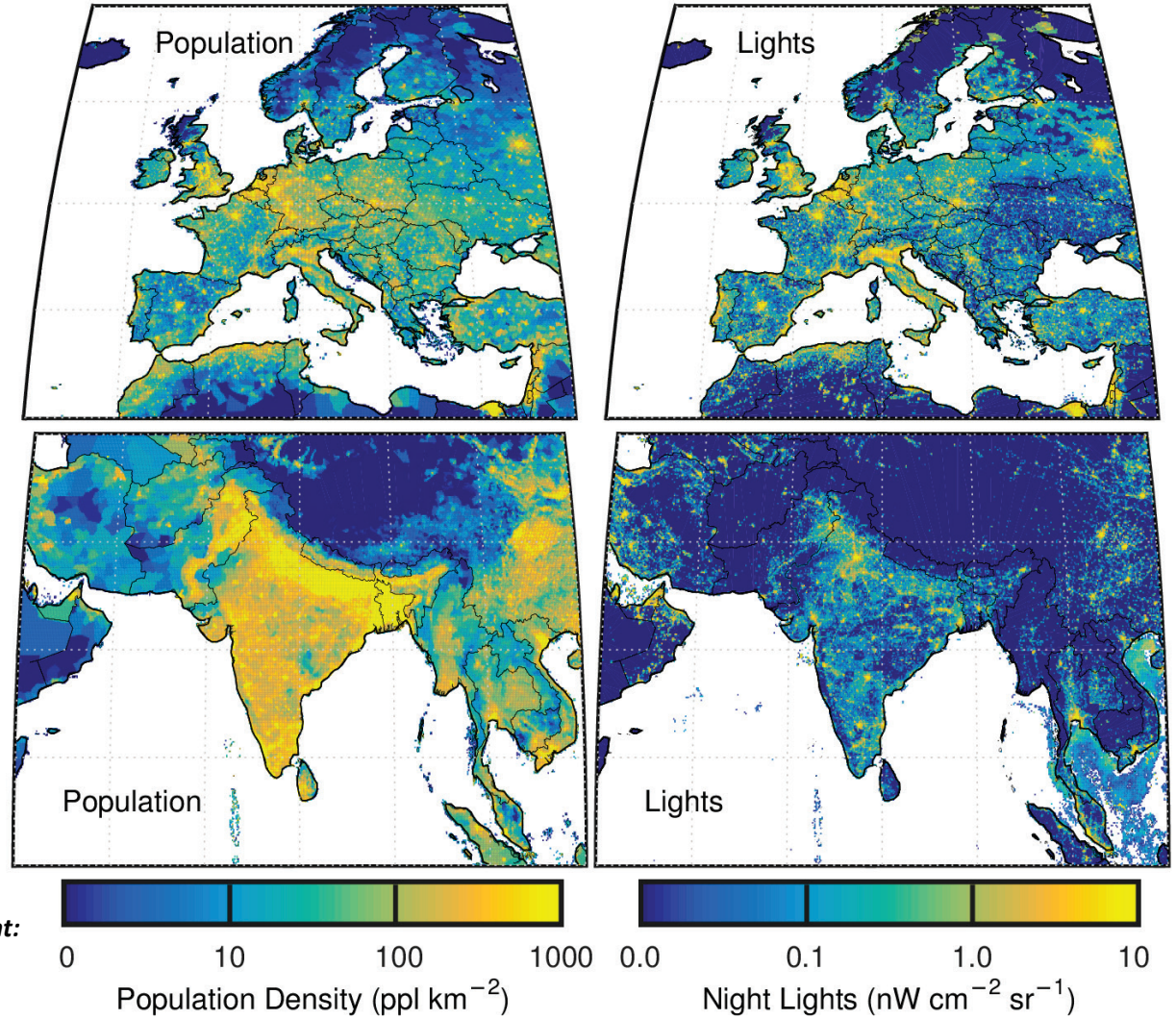

Fig 4.8
Paris Climate Agreement: Beacon of Hope

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Discussion #1: Tuesday

- Chapter 2 of *Collapse* by Diamond (41 pages)
- AT 01: 4 questions; due 5 mins before start of class
- Template to help the discussion leader posted at:
  http://www.atmos.umd.edu/~rjs/class/honr229L/lectures/HONR_229L_2019_discussion01_template.ppt

Discussion #1: Tuesday

https://www.atmos.umd.edu/~rjs/class/honr229L/

Most Visited | Getting Started | Most Visited | Getting Started | Q10-4_wmo2018_ani... | Business Roundtable

09/03	Past Societies, Failure: Easter Island	Diamond: Ch 2 (41 pages)	AT 1	tbd Template	Discussion 1 Video	Nova Special Rapa Nui Book Rapa Nui Movie
09/05	Past Societies, Failure: The Maya	Diamond: Prologue (24 pages) & Ch 5 (21 pages)	AT 2	tbd Template	Discussion 2 Video **Paper Desc**	Mayan Drought New Mayan Codex Ground Water in the news
09/10	Past Societies, Success: New Guinea, Tikopia and Japan	Diamond: Ch 9 (32 pages)	AT 3	tbd Template	Discussion 3 Video	India Population News Article
09/12	Modern Societies: Dominican Republic and Haiti	Diamond: Ch 11 (29 pages)	AT 4	tbd Template	Discussion 4 Video	Recent News Haitian TPS Hurricanes and Climate Coastal Development in NC
09/17	Modern Societies: China	Diamond: Ch 12 (20 pages)	AT 5	tbd Template	Discussion 5 Video	Obama Xi announcement Obama Xi commitment Obama Xi Fact Sheet Trump Reversal Kuznets Curve
09/19	Roadmaps for Success or Failure	Diamond: Ch 14 (22 pages)	AT 6 **Paper Desc**	tbd Template	Discussion 6 Video	Silent Spring Ozone Layer
09/24	Business and the Environment	Diamond: Ch 15 (can skip section on seafood industry; please read last part that begins "In brief, environmental practices") (41 pages) Aug 2019 Business Roundtable Release Aug 2019 Business Roundtable Meeting Challenges	AT 7	tbd Template	Discussion 7 Video	Nova Rare Earth Metals Chevron in Ecuador, I Chevron in Ecuador, II Volkswagen DieselGate Surui, Amazon
09/26	Introduction to Climate Change	IPCC 2007 FAQ (36 pages)	AT 8	tbd Template	Discussion 8 Video	Global Warming Animation

Easter Island: Fascinating story with a "punchline"

Maya: Interesting climate / water availability twists

Three success stories!

Outcome due to environmental determinism or human decisions

Insight into demographics of China: a lot has changed since this chapter was written

Food for thought about how societies make decisions

Insightful accounts of logging and mining industries, as well as importance of environmental stewardship

Finally! But this 7 discussion back-drop is very important because "those who can not remember the past may be condemned to repeat it"

Greta Thunberg

https://twitter.com/GretaThunberg/status/1166794869630787584/photo/1