





Net Zero Emissions
Why and How

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Global Energy Considerations

Update to the Paris Agreement

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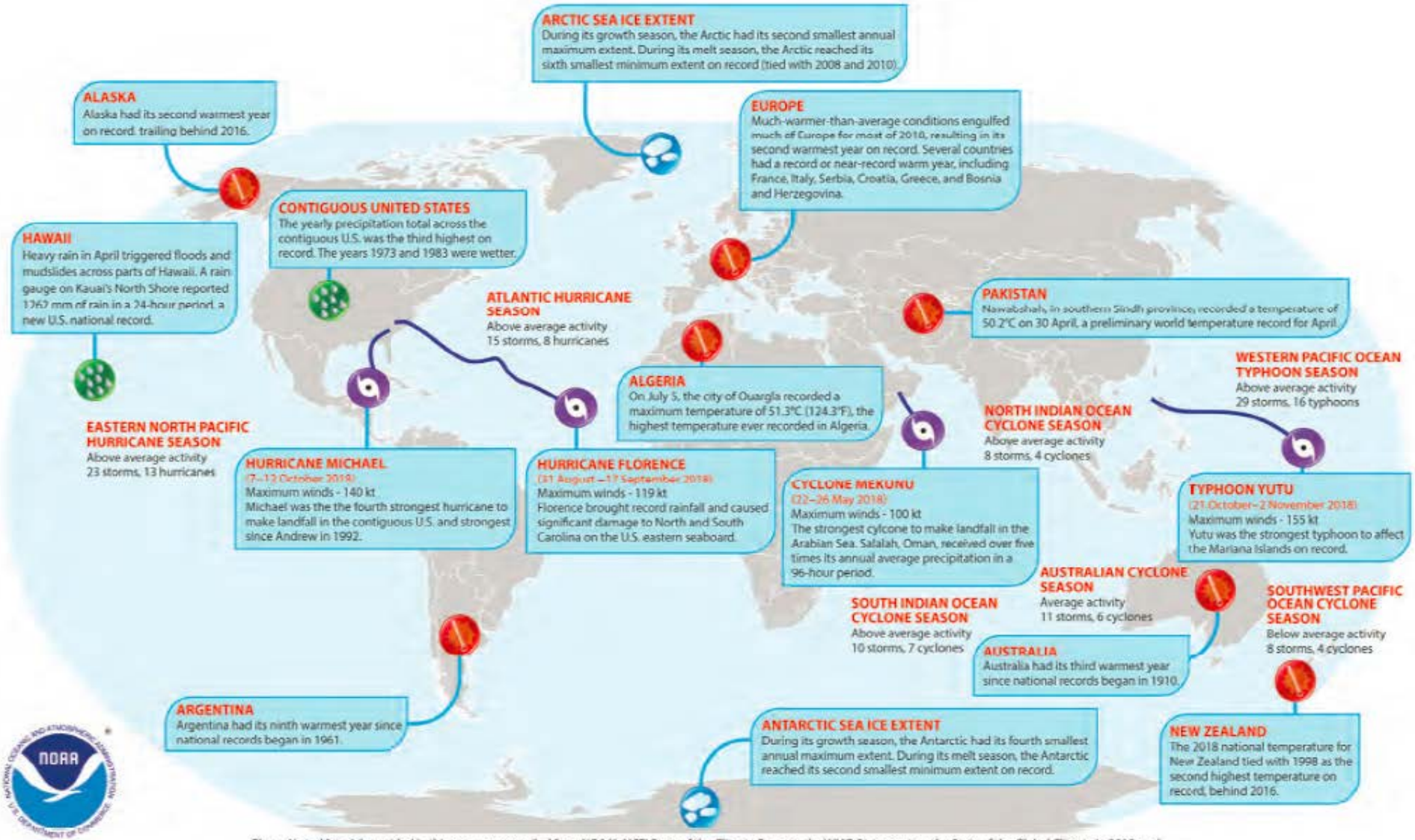
February, 2020

Global Energy and Paris Agreement Outline

- Extreme weather
- Other GHG: methane and refrigerants
- Kaya identity
- International Efforts on Climate Change and Energy Policy: UNFCCC and IPCC
- The Paris Agreement COP-21
- Nationally Determined Contributions
- Green Climate Fund
- More COPs
- Climate strike
- Summary

Extreme Weather

Extreme Weather Events in 2018



Please Note: Material provided in this map was compiled from NOAA's NCEI State of the Climate Reports, the WMO Statement on the State of the Global Climate in 2018, and authorship for this report. For more information please visit: http://www.ncdc.noaa.gov/sotc

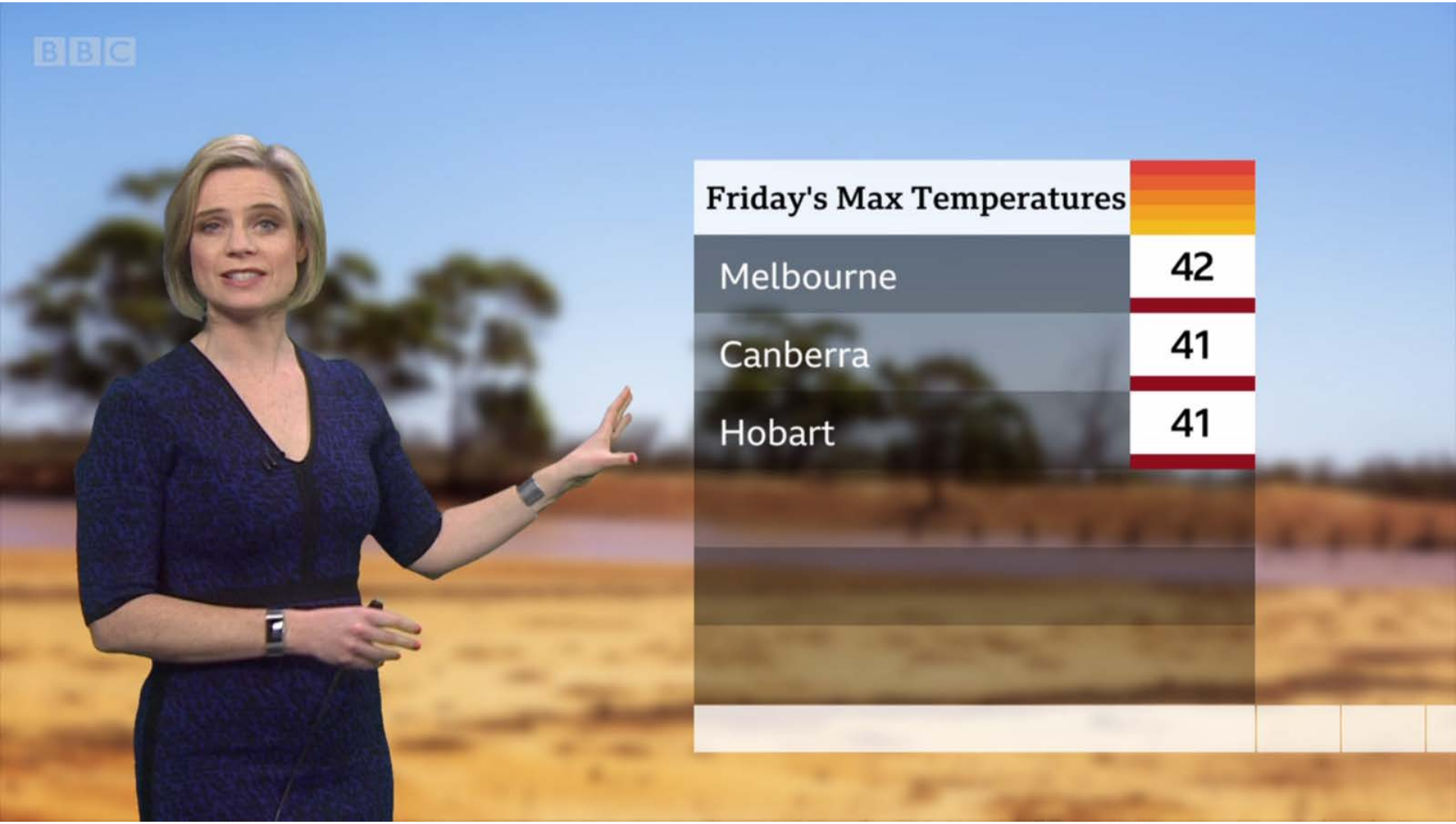
Selected Extreme Weather Events in 2018

- Alaska 2nd warmest year
- Arctic sea ice extent 2nd smallest maximum
- United States 3rd highest precipitation
- Hurricane Michael 4th strongest to make U.S. landfall
- Argentina warmest year since 1961
- Pacific hurricane above average
- Algeria city of Ouargla experiences 51.3°C
- Pakistan city of Nawavsha experiences 50.2°C
- Australia 3rd warmest year on record
- Pacific typhoon above average
- Antarctica sea ice 4th smallest maximum

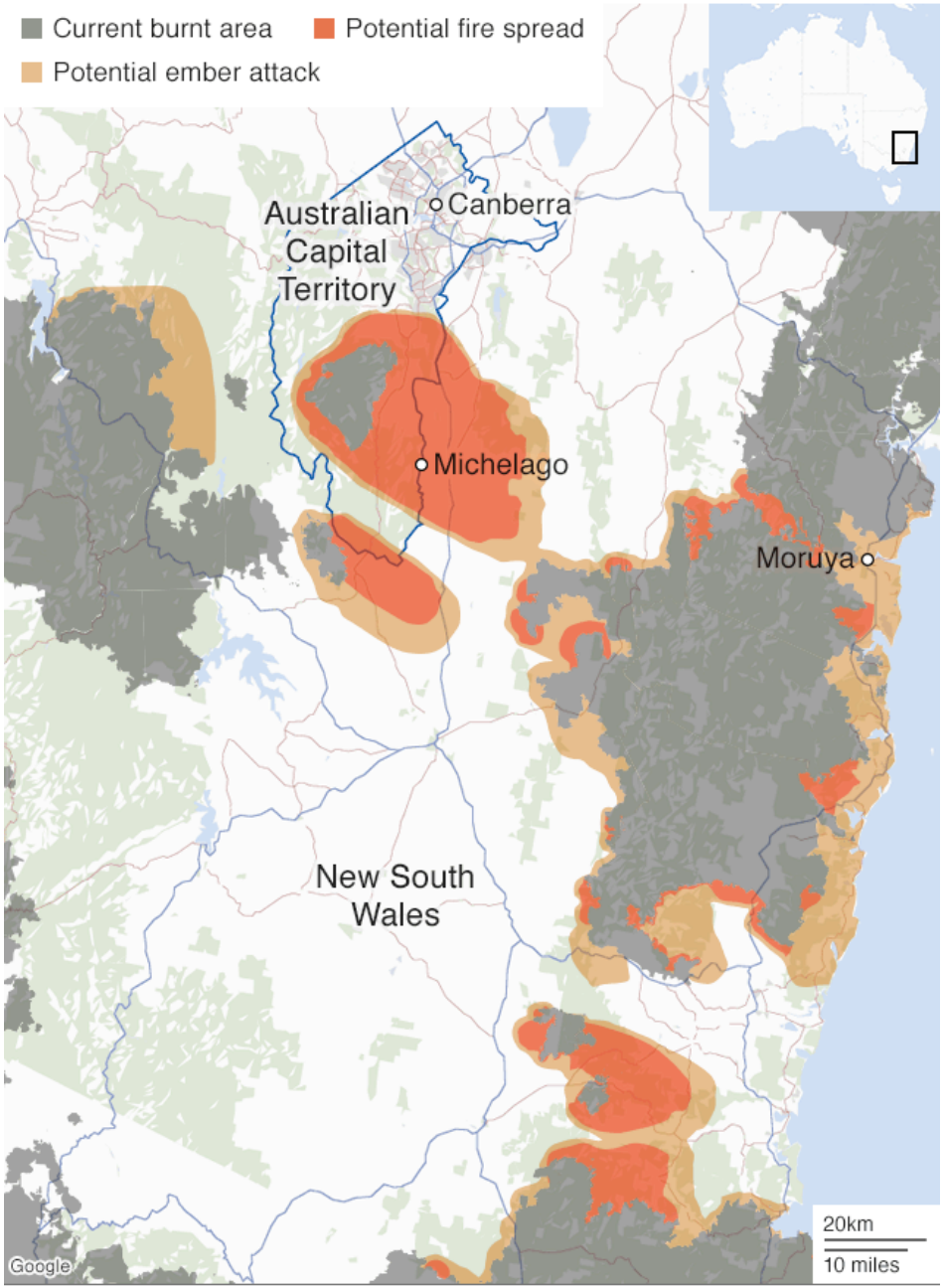
CarbonBrief
CLEAR ON CLIMATE

Map of Extreme Weather Events in 2018

BBC Weather January 31, 2020



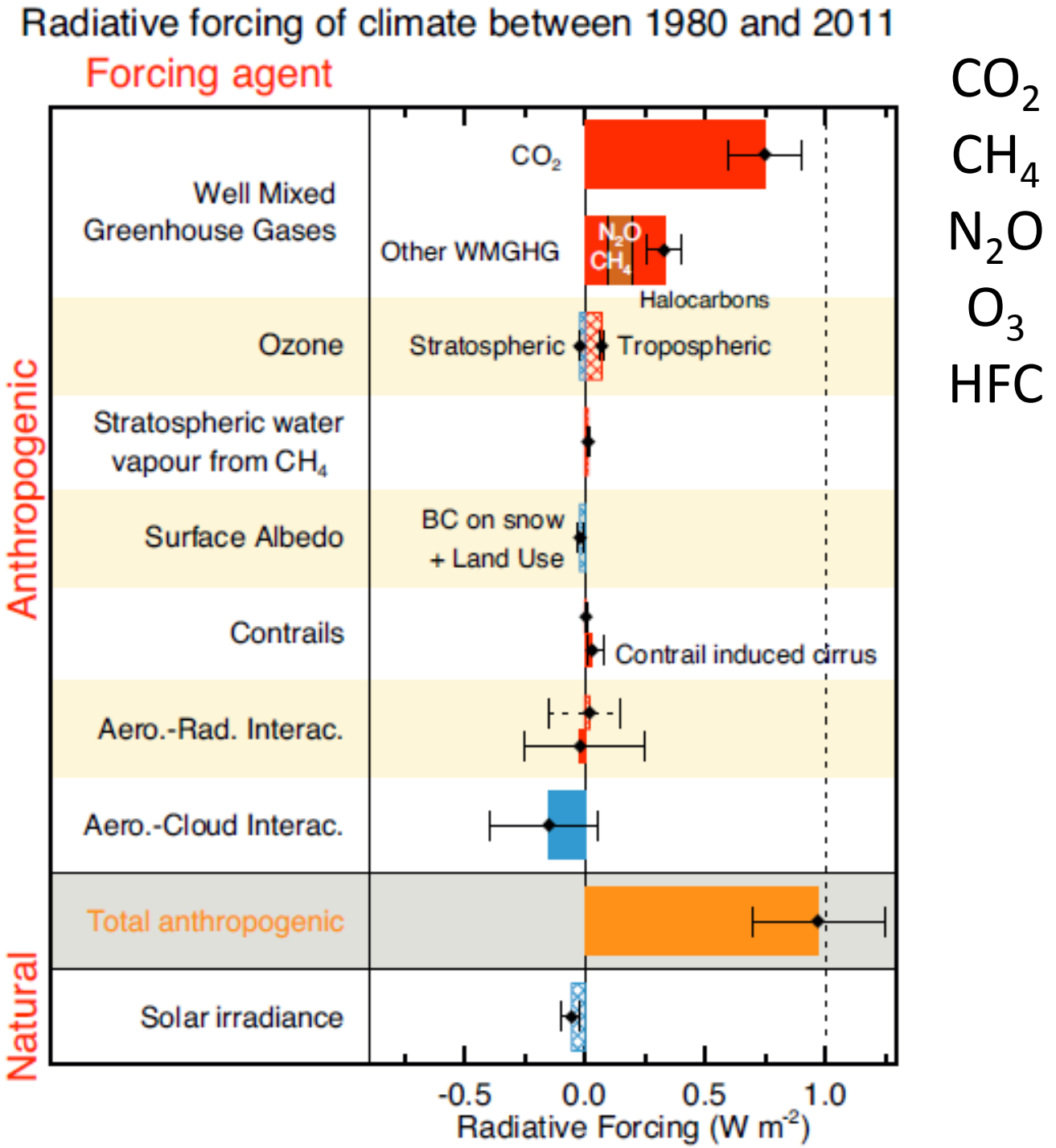
Fire spread predictions for NSW and Canberra area for Saturday 1 February



Source: NSW Rural Fire Service

BBC

Other Greenhouse Gases



CO_2

CH_4

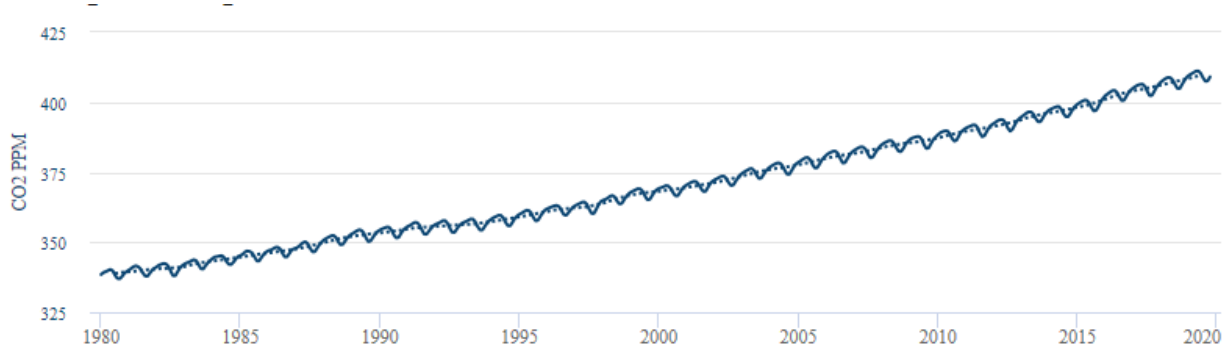
N_2O

O_3

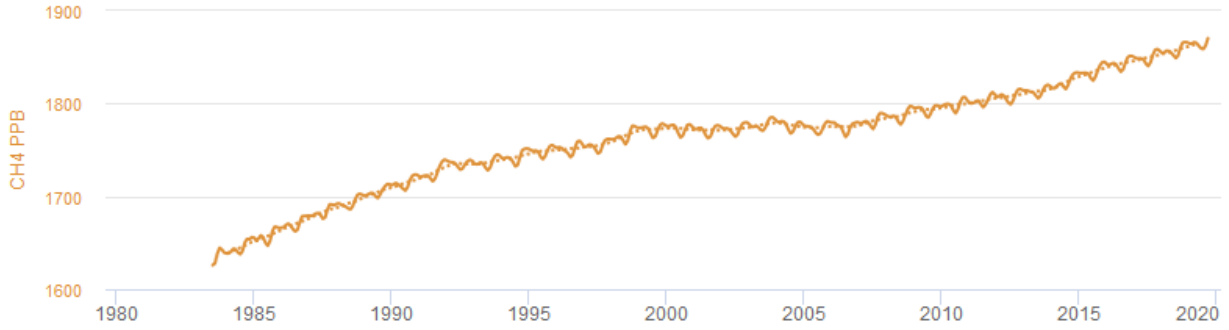
HFC

Global Greenhouse Gas Concentrations

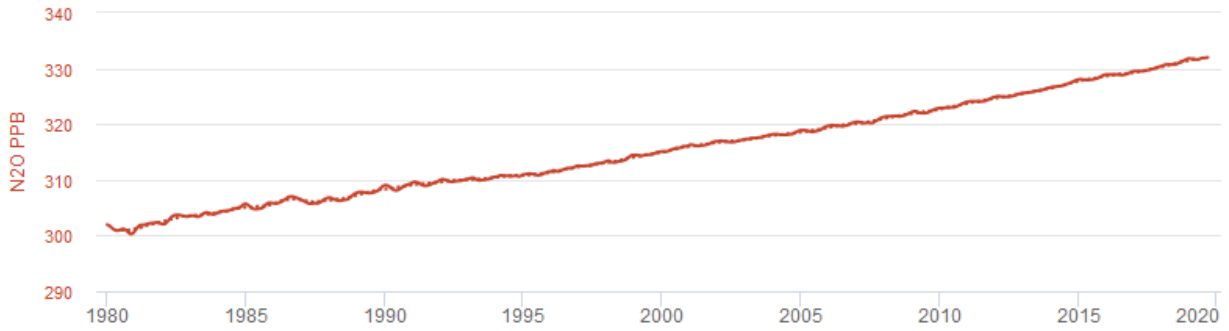
CO_2



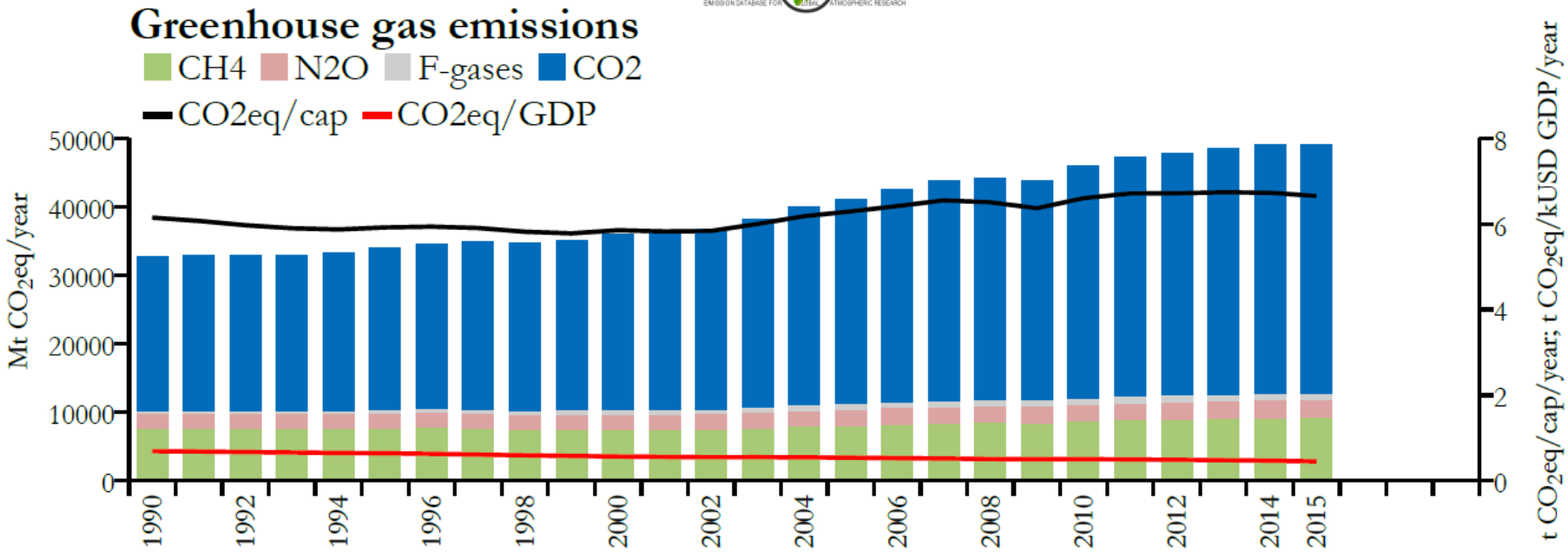
CH_4



N_2O



CO_2 versus CO_{2eq}



Year	Mt CO_2/yr	GHG: Mt CO_{2eq}/yr	t CO_2/cap/yr	GHG: t CO_{2eq}/cap/yr	t CO_2/kUSD/yr
2018	37887.224	n/a	4.968	n/a	0.314
2015	36311.982	49113.311	4.922	6.657	0.334
2005	29911.661	41163.349	4.576	6.297	0.390
1990	22637.134	32772.532	4.249	6.151	0.475

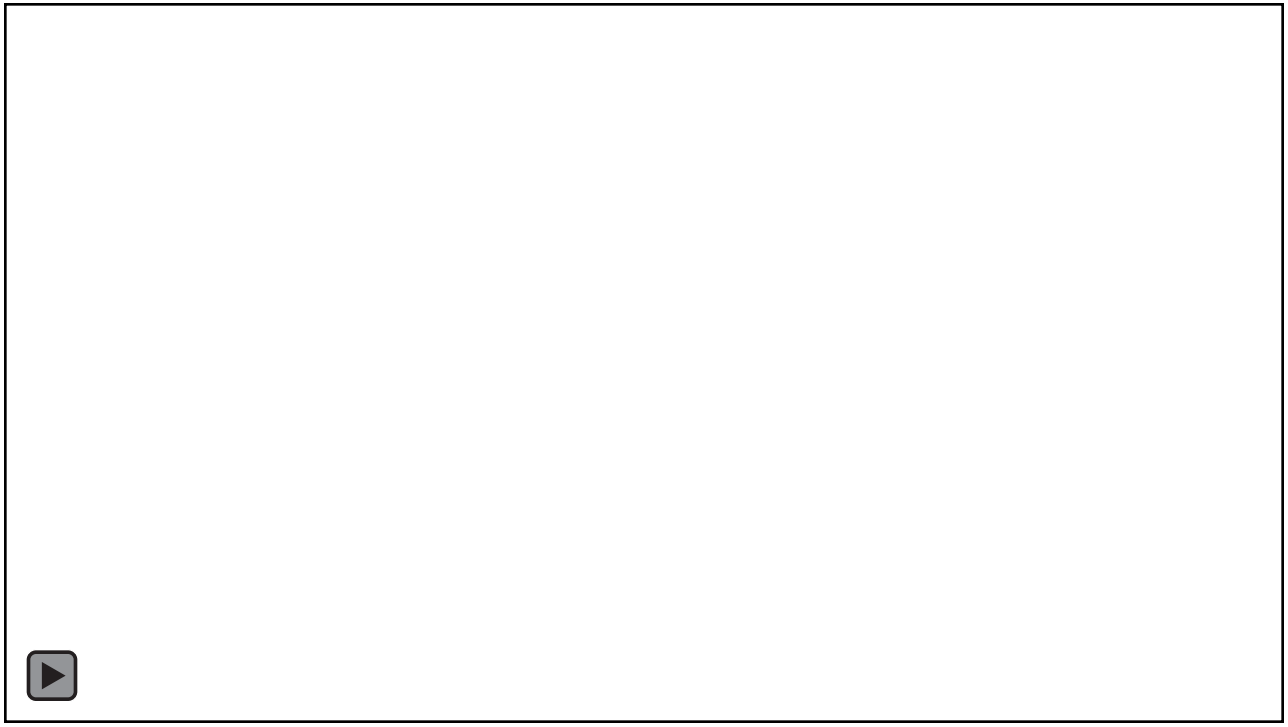
Methane (Natural Gas)

The New York Times

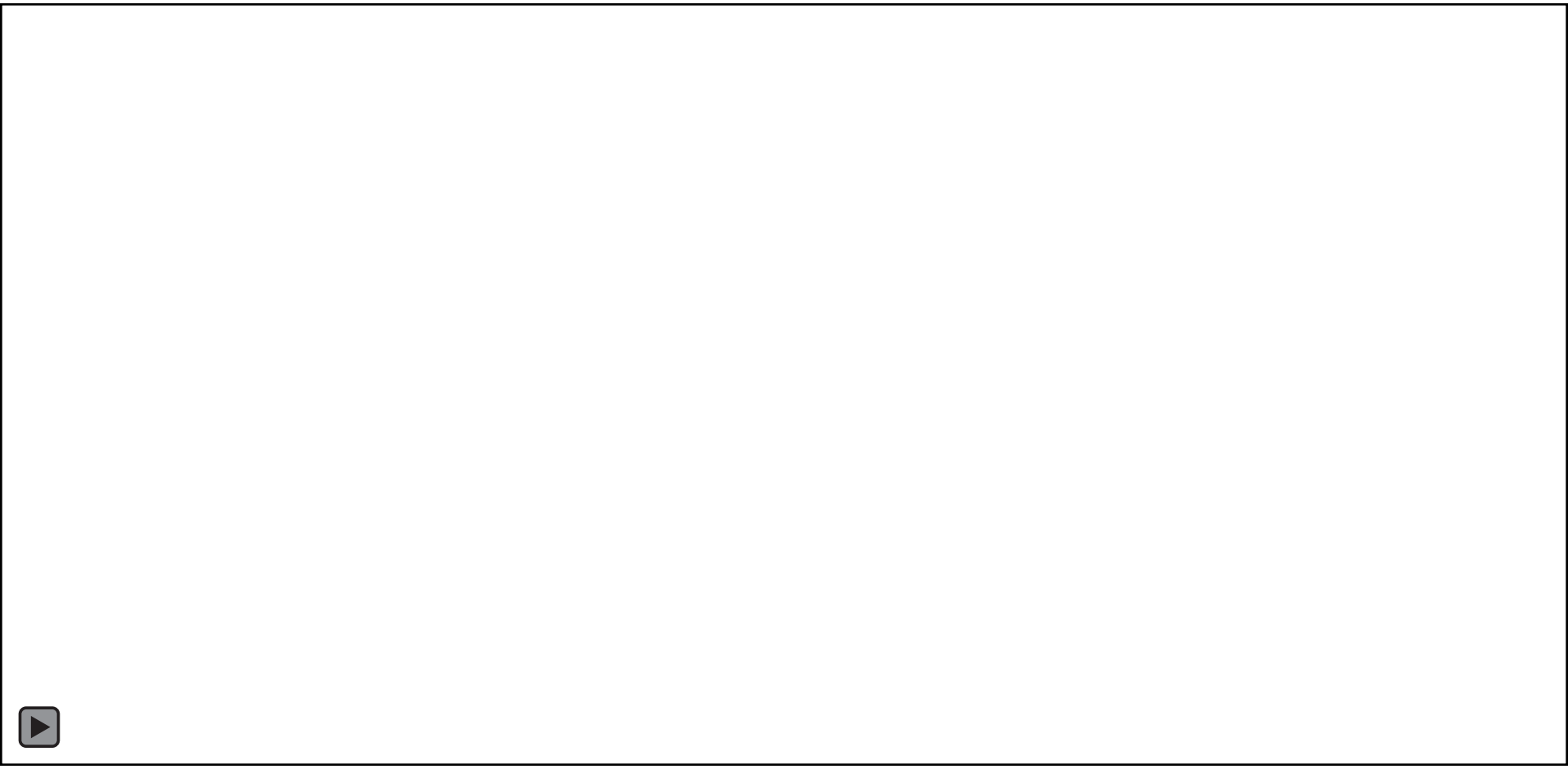
August 29, 2019

E.P.A. to Roll Back Regulations on Methane, a Potent Greenhouse Gas

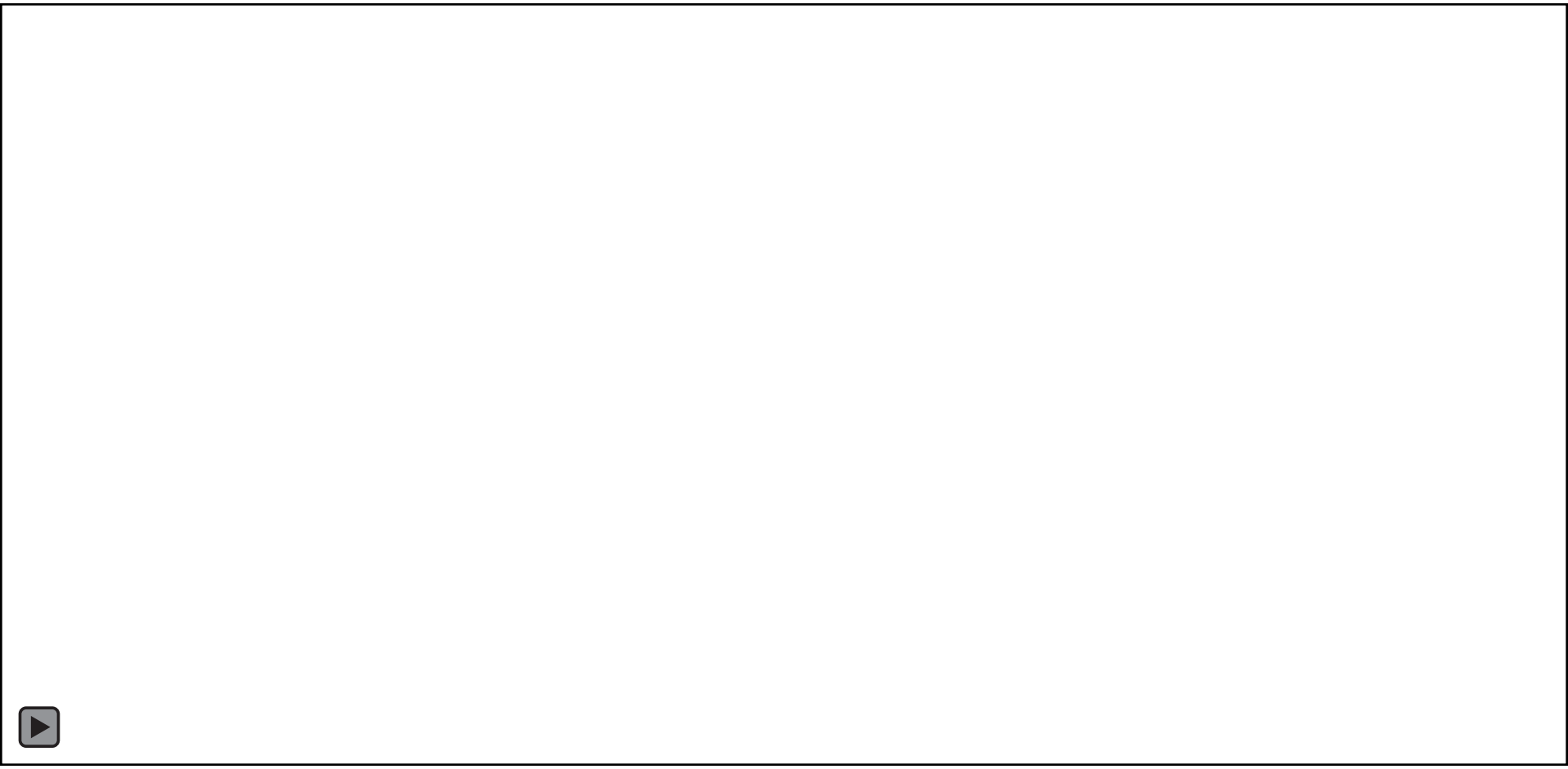
Aerial Footage of Aliso Canyon Natural Gas Leak



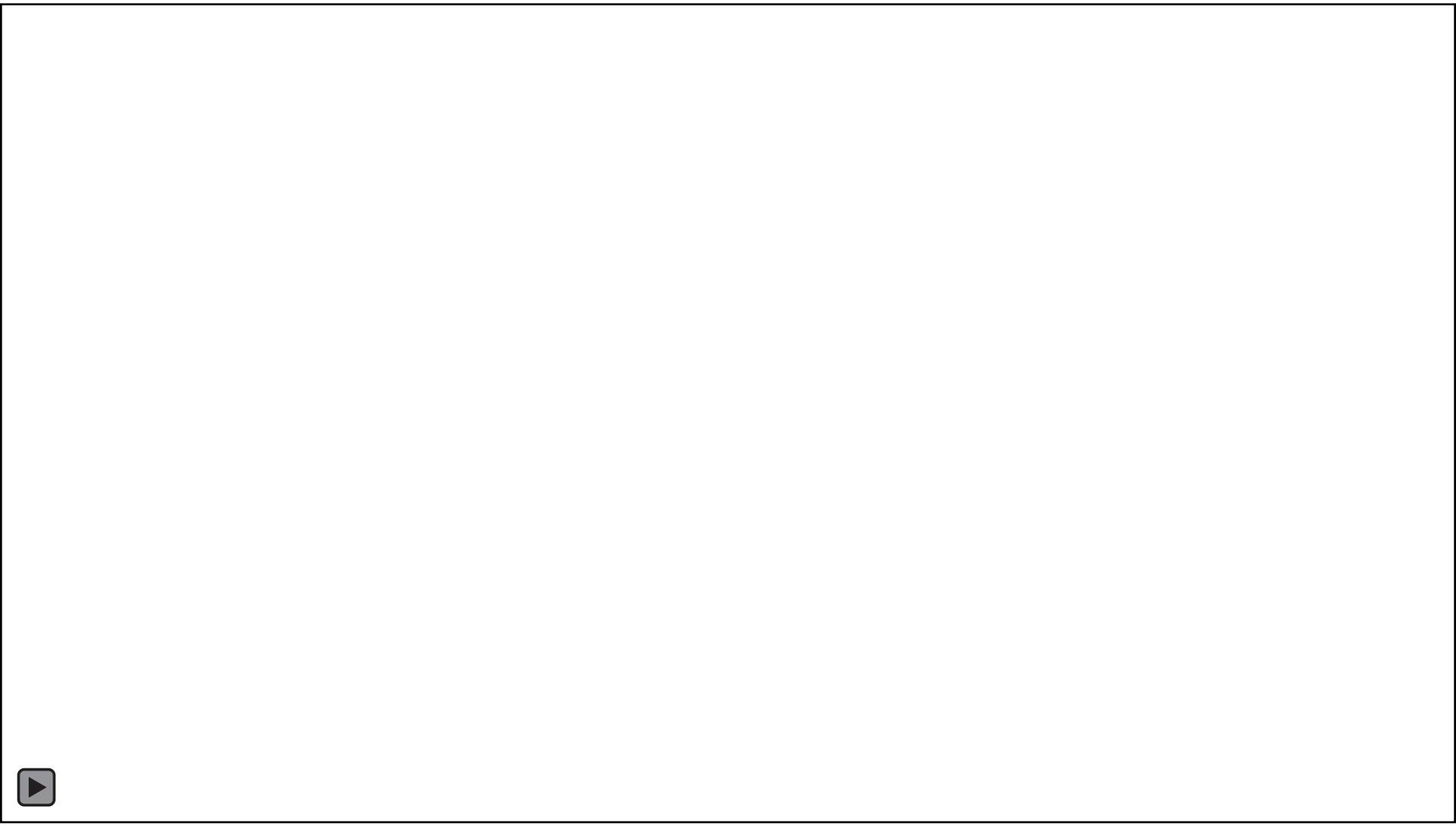
Methane Leak 1



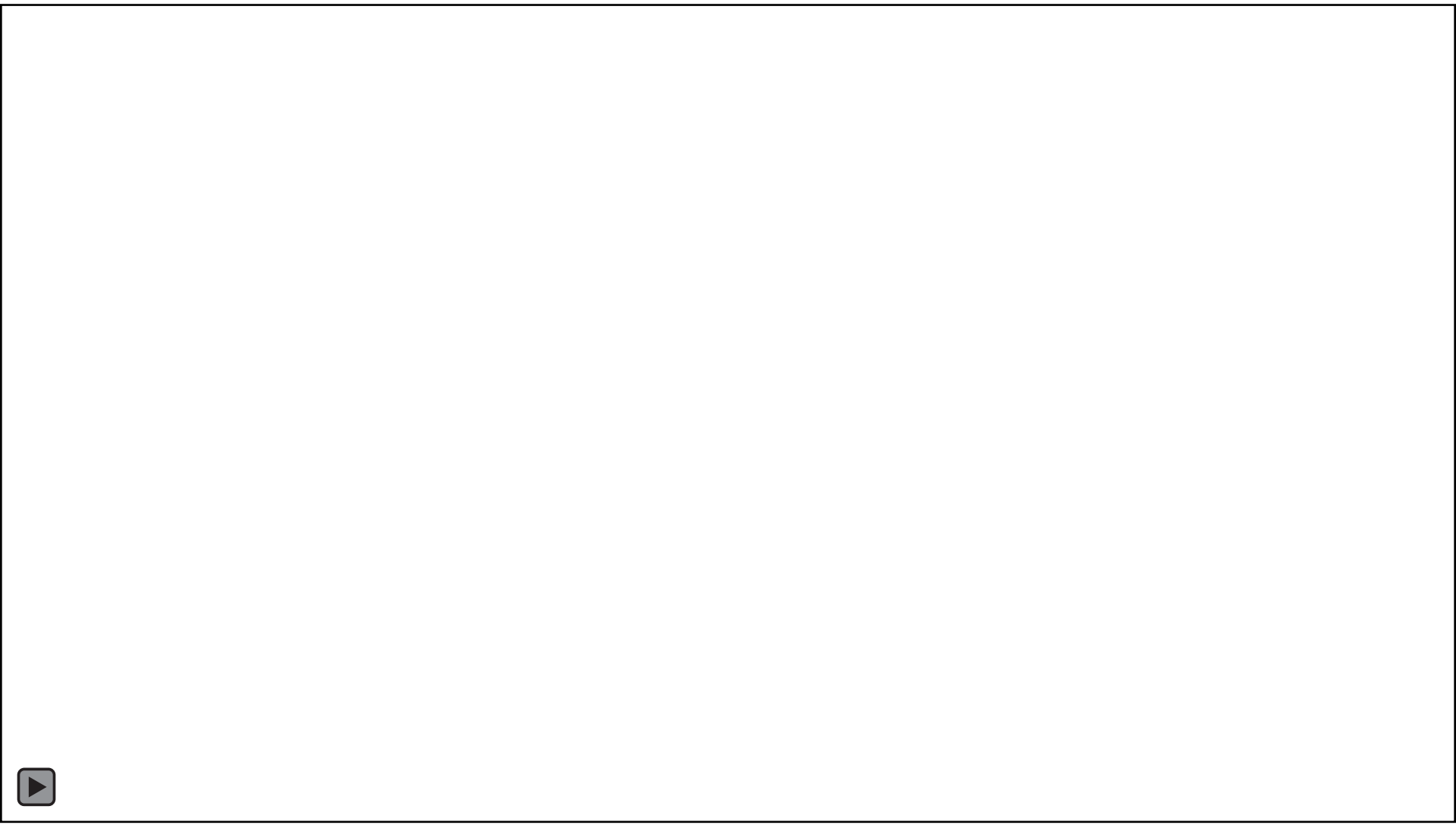
Methane Leak 2



Methane Leak 3



Natural Gas Flaring



Ozone
CFC
HCFC
HFC

Nature 249(1974)810

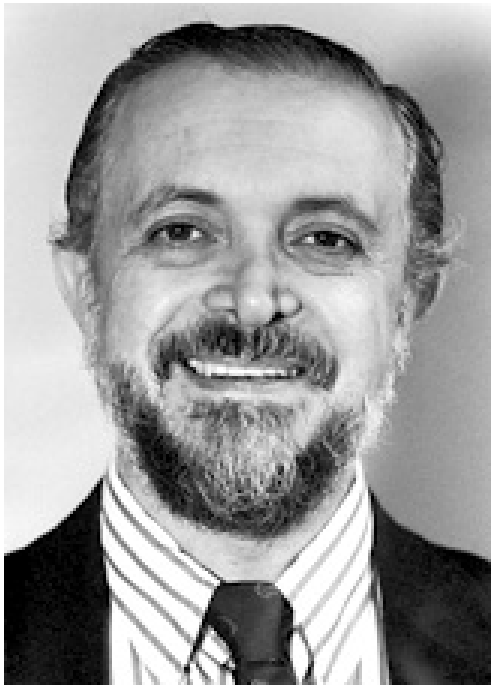
Mario J. Molina & F. S. Rowland

Stratospheric sink for chlorofluoromethanes: chlorine atom catalyzed destruction of ozone

$$Cl + O_3 \rightarrow ClO + O_2$$
$$ClO + O \rightarrow Cl + O_2$$

Nobel Prize in Chemistry 1995

Paul J. Crutzen

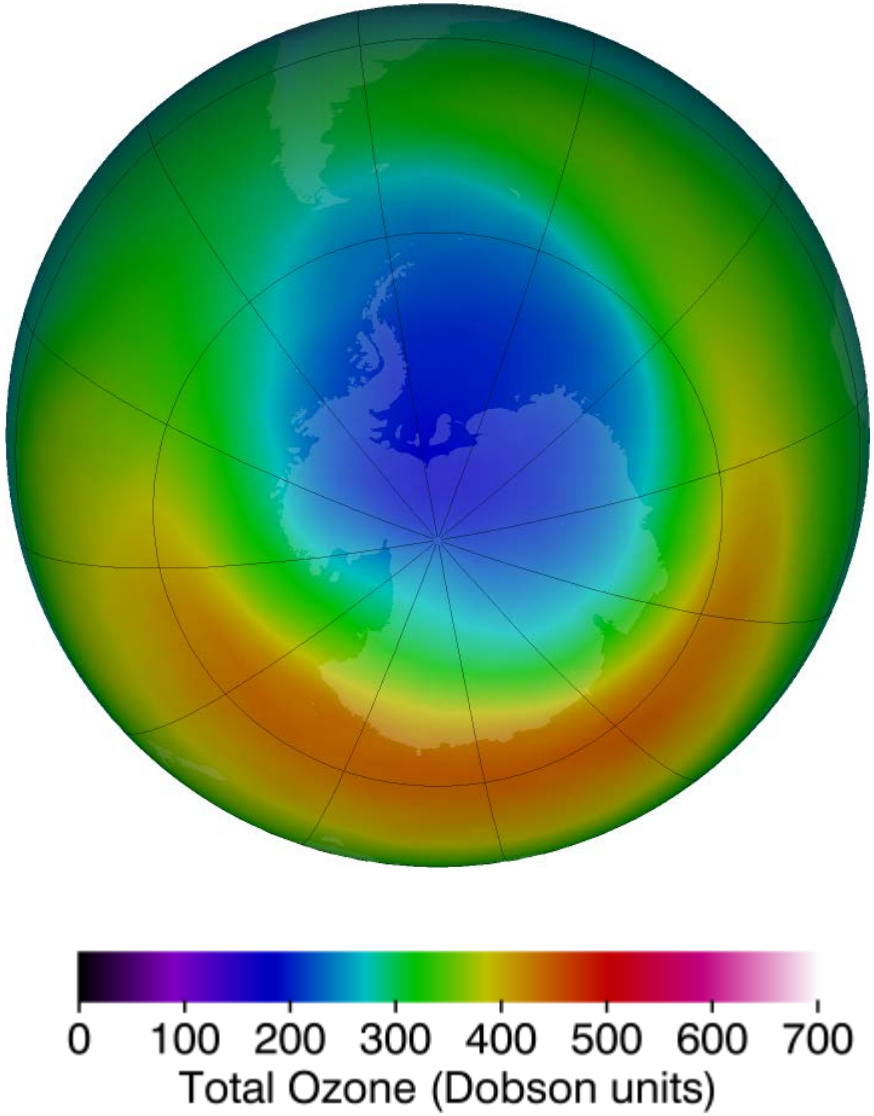


Mario J. Molina

F. Sherwood Rowland

"for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone".

NASA Goddard Space Flight Center Ozone Hole Watch September, 2019



The Montreal Protocol

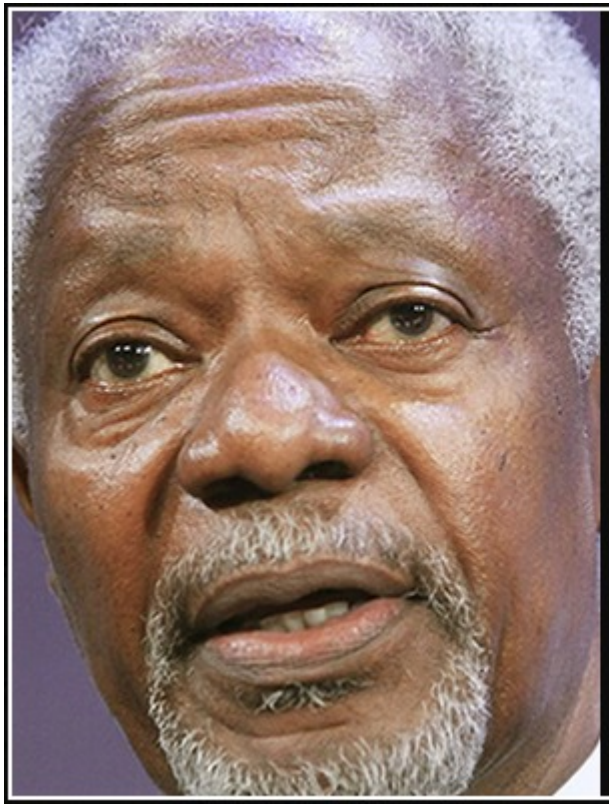
Timeline of Montreal Protocol and Amendments at selected meetings

- 1987 Montreal Protocol on Substances that Deplete the Ozone Layer signed by 24 countries, eventually all countries sign
  - Reduce certain CFC use 50% by 1999
  - 10 year grace period for developing countries
  - International fund to support developing countries efforts
- 1990 London
  - Eliminate CFCs, certain halons, CCl_4 by 2000
- 1992 Copenhagen
  - Eliminate CFCs by 1995, halons by 1993, CCl_4 by 1995, HCFC by 2029
- 1999 Beijing
  - Freeze HCFC production by 2003
- 2007 Montreal
  - Phase out use of HCFC in developed countries by 2020
  - Set schedule for phase out of HFCF in developing countries
- 2016 Kigali
  - Set schedule for reduction of HFC use with goal of 80% by 2050

President Reagan Announcing Support of Montreal Protocol

Ronald Reagan Statements on Signing the Montreal Protocol (1988)

- “I am pleased to sign the instrument of ratification for the Montreal protocol on substances that deplete the ozone layer.”
- “I believe the Montreal protocol, negotiated under the auspices of the United Nations Environment Program, is an extremely important environmental agreement.”
- “A mechanism for adjustment of the protocol is established to allow for changes based upon the review process. The wisdom of this unique provision is already being realized.“
- “The Montreal protocol is a model of cooperation.”



Perhaps the single most successful international agreement to date has been the Montreal Protocol.

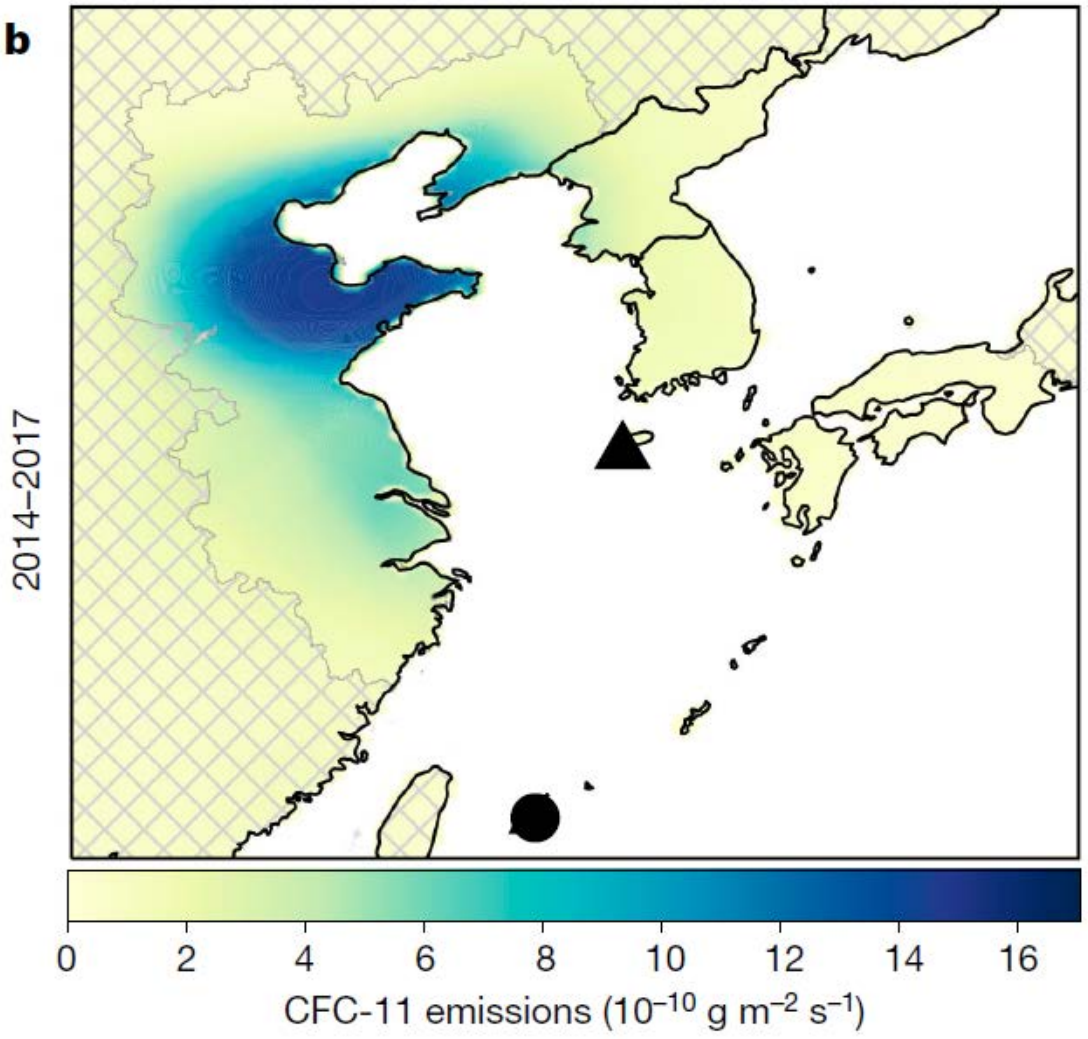
— Kofi Annan —

The New York Times

November 3, 2019

More Evidence Points to China as Source of Ozone-Depleting Gas

CFC-11 Emissions from Satellite Measurements



Kaya Identity

Country and Regional Energy Consumption and Emissions Comparisons

Kaya Identity

$$Global\ CO_2\ emissions =$$

$$\left(Global\ population\right)\times$$

$$\left(\frac{Gross\ world\ product}{Global\ population}\right)\times$$

$$\left(\frac{Gross\ energy\ consumption}{Gross\ world\ product}\right)\times$$

$$\left(\frac{Global\ CO_2\ emissions}{Gross\ energy\ consumption}\right)$$


F = Global CO_2 emissions
Includes combustion, flaring of natural gas, cement production, oxidation of non-fuel hydrocarbons
g = Consumption per person
(Gross world product / Population)
P = Global population
Total number of human beings — ie: 6 billion
F=Pgef
e = Energy intensity of gross world product
(Gross energy consumption / Gross world product)
f = Total carbon used to make energy
(Global CO_2 emissons / Gross energy consumption)

$$\frac{CO_2\ emissions}{energy\ consumption}$$

This ratio is about the fuel

$$\frac{energy\ consumption}{product}$$

This ratio is about efficiency

$$\frac{product}{population}$$

This ratio is about the level of development

Kaya Identity Example - World

From BP Statistical Analysis 2019 (2018 data) and World Bank 2018

Global CO_2 emissions: 33.9 Gt CO_2
Global energy consumption 549.3 quads
Global domestic product: $85.9 trillion (2018 US$)
Global population 7,632 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

$$CO_2\ emissions = \frac{61.7\,tCO_2}{10^9\ BTU}\frac{6,400\,BTU}{\$}\frac{\$11,260}{person}7,632\ million\ persons$$

CO_2 intensity of energy supply

energy intensity of economic output

economic output per capita

Kaya Identity Example – U.S.

From EIA International Energy Outlook 2016 (2012 data) and World Bank 2013

U.S. CO_2 emissions: 5.1 Gt CO_2
U.S. energy consumption 91.2 quads
U.S. domestic product: $20.5 trillion (2018 US$)
U.S. population 326 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

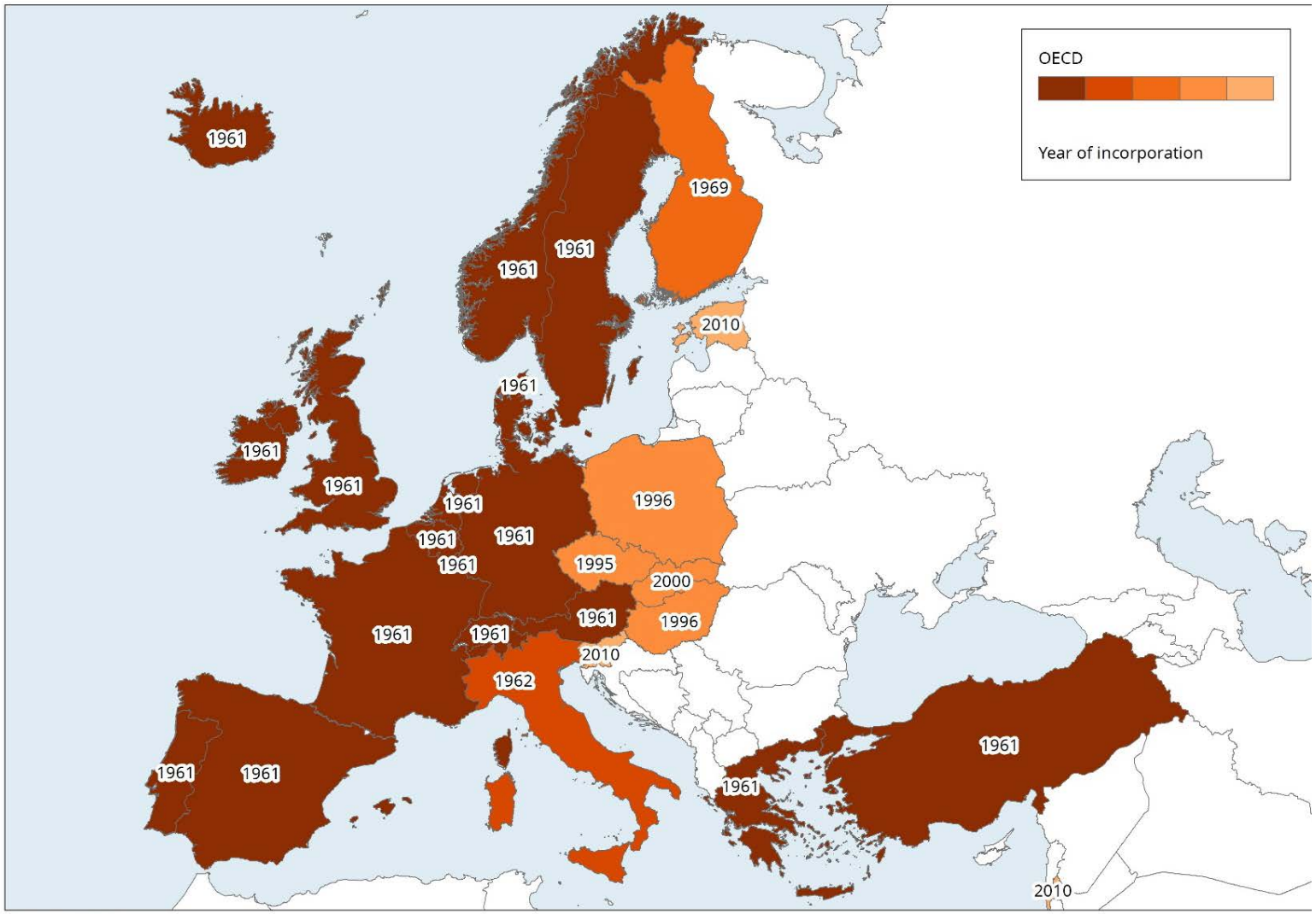
$$CO_2\ emissions = \frac{56.4\,tCO_2}{10^9\,BTU}\frac{4,440\,BTU}{\$}\frac{\$62,900}{person}326\ million\ persons$$

CO_2 intensity of energy supply

energy intensity of economic output

economic output per capita

28 Members of OECD Europe



Source: OECD

28 Members of European Union

Kaya Identity Example – OECD

From BP Statistical Analysis 2019 (2018 data) and World Bank 2018

OECD CO_2 emissions: 12.4 Gt CO_2
OECD energy consumption 224.8 quads
OECD domestic product: $52.7 trillion (2018 US$)
OECD population 1,299 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

$$CO_2\ emissions = \frac{55.2\,tCO_2}{10^9\ BTU}\frac{4,270\,BTU}{\$}\frac{\$40,550}{person}1,299\ million\ persons$$

CO_2 intensity of energy supply

energy intensity of economic output

economic output per capita

Kaya Identity Example – EU

From BP Statistical Analysis 2019 (2018 data) and World Bank 2018

EU CO_2 emissions: 3.48 Gt CO_2
EU energy consumption 66.9 quads
EU domestic product: $18.8 trillion (2018 US$)
EU population 509 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

$$CO_2\ emissions = \frac{52.0\,tCO_2}{10^9\ BTU}\frac{3{,}570\,BTU}{\$}\frac{\$36{,}900}{person}509\ million\ persons$$

CO_2 intensity of energy supply

energy intensity of economic output

economic output per capita

Kaya Identity Example – China

From BP Statistical Analysis 2019 (2018 data) and World Bank 2018

China CO_2 emissions: 9.5 Gt CO_2
China energy consumption 130 quads
China domestic product: $13.61 trillion (2012 US$)
China population 1,413 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

$$CO_2\ emissions = \frac{72.6\,tCO_2}{10^9\ BTU}\frac{9{,}540\,BTU}{\$}\frac{\$9{,}630}{person}1{,}413\ million\ persons$$

CO_2 intensity of energy supply

energy intensity of economic output

economic output per capita

Kaya Identity Example – India

From BP Statistical Analysis 2019 (2018 data) and World Bank 2018

India CO_2 emissions: 2.5 Gt CO_2
India energy consumption 32.1 quads
India domestic product: $2.872 trillion (2012 US$)
India population 1,354 million

$$CO_2 = \frac{CO_2}{Energy}\frac{Energy}{GDP}\frac{GDP}{capita}Population$$

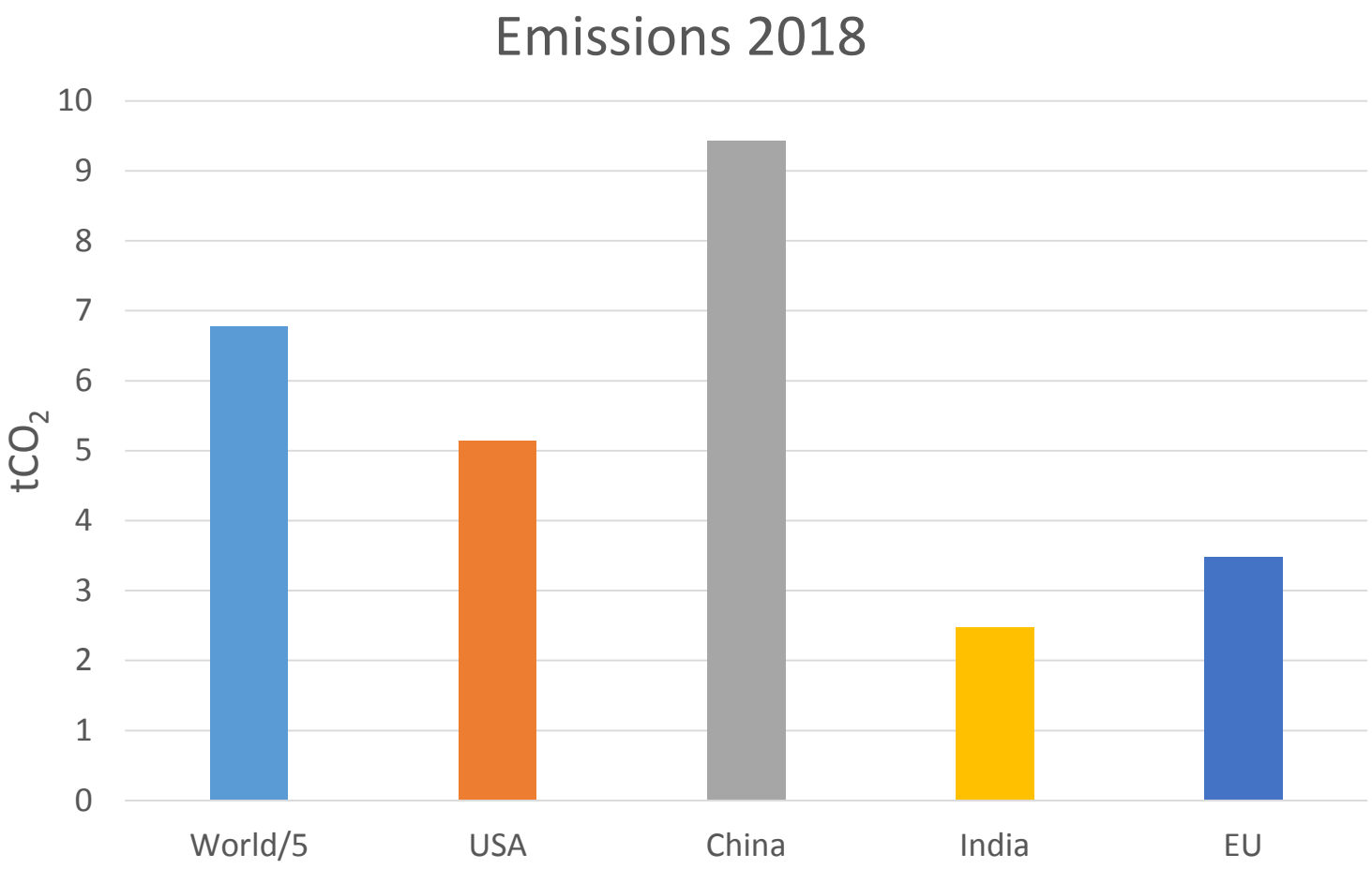
$$CO_2\ emissions = \frac{77.3 tCO_2}{10^9\ BTU}\frac{11{,}800\ BTU}{\$}\frac{\$2{,}008}{person}1{,}343\ million\ persons$$

CO_2 intensity of energy supply

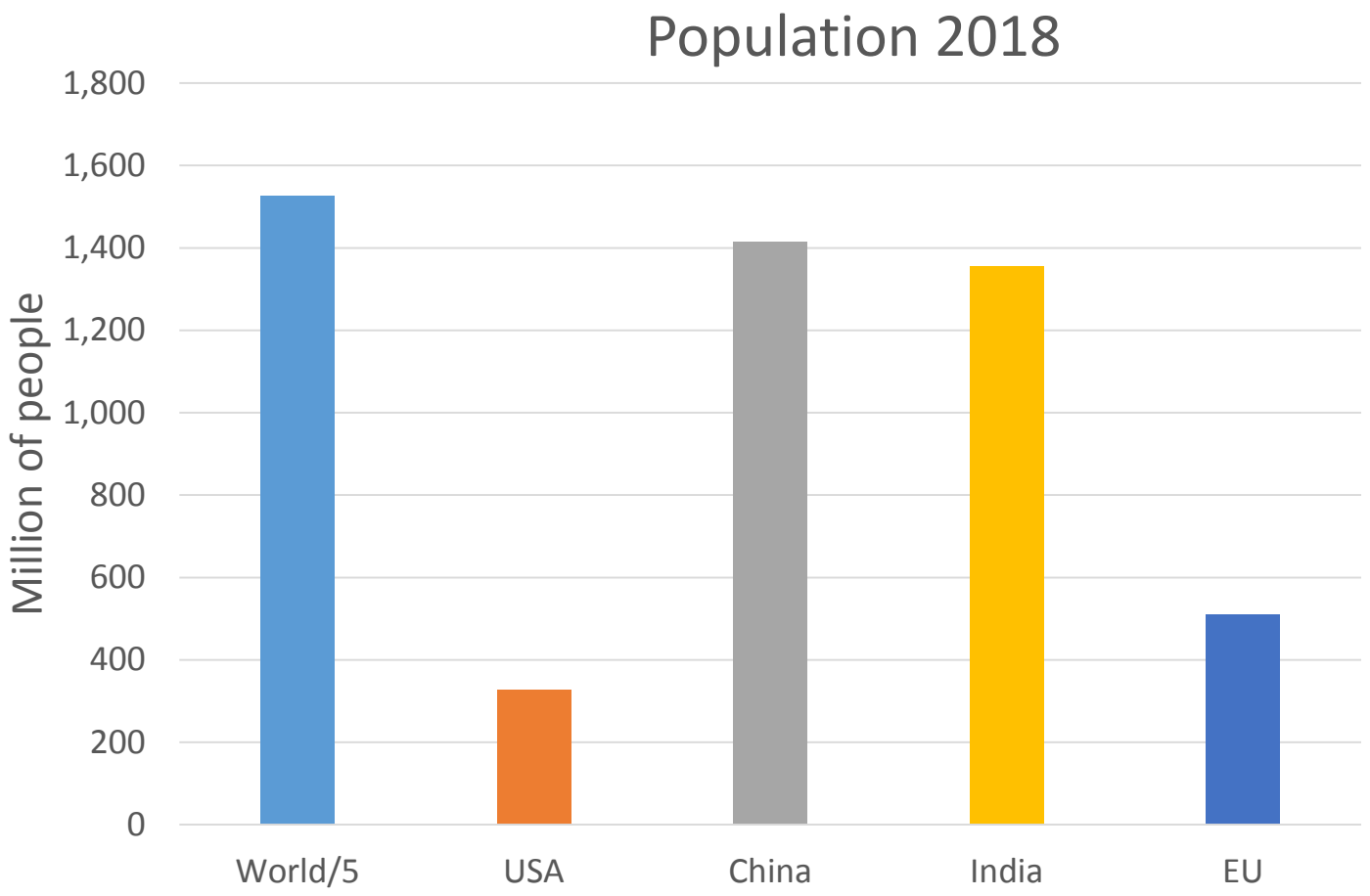
energy intensity of economic output

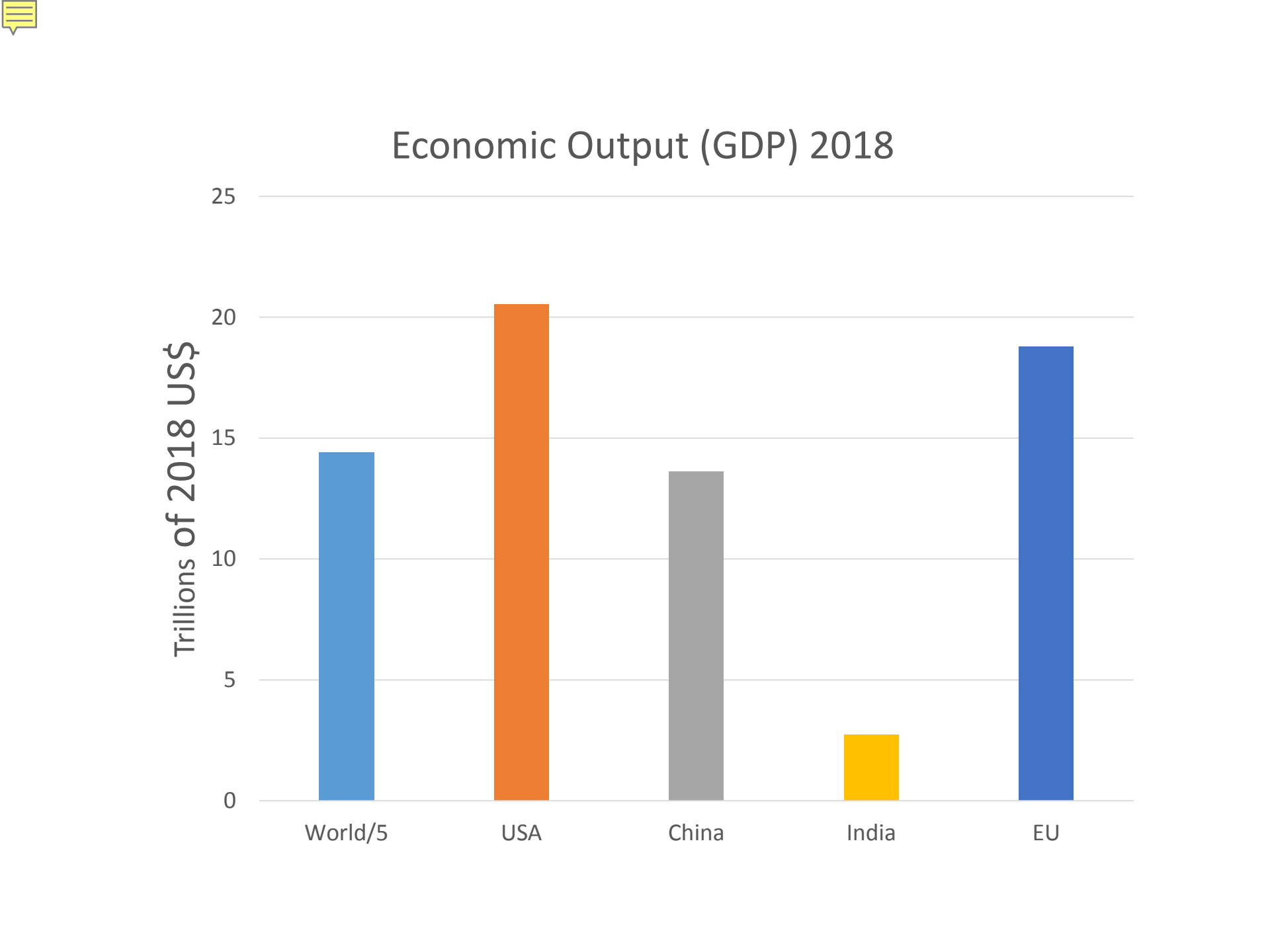
economic output per capita

F = Global CO_2 emissions
Includes combustion, flaring of natural gas, cement production, oxidation of non-fuel hydrocarbons



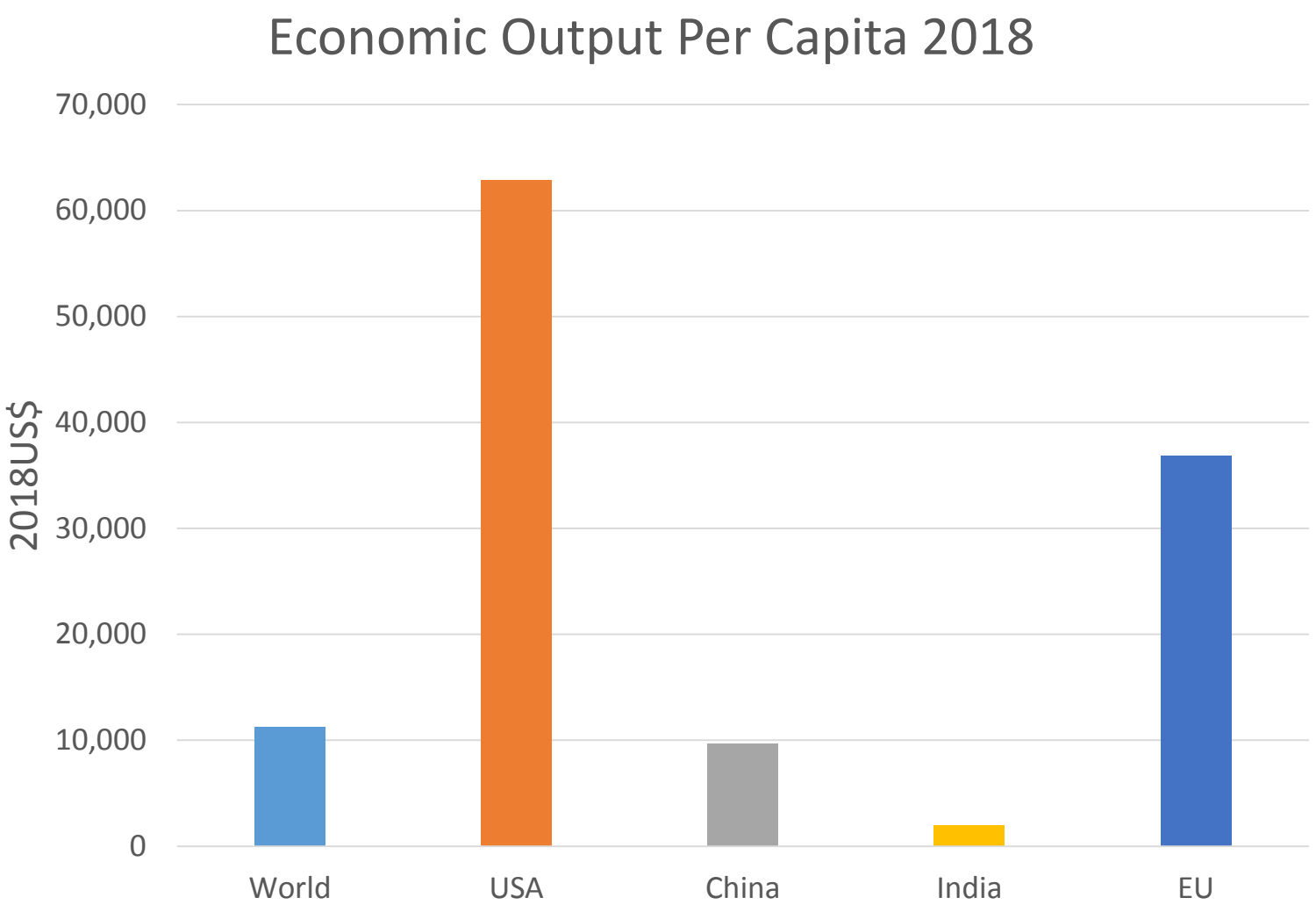
P = Global population
Total number of human beings — ie: 7 billion

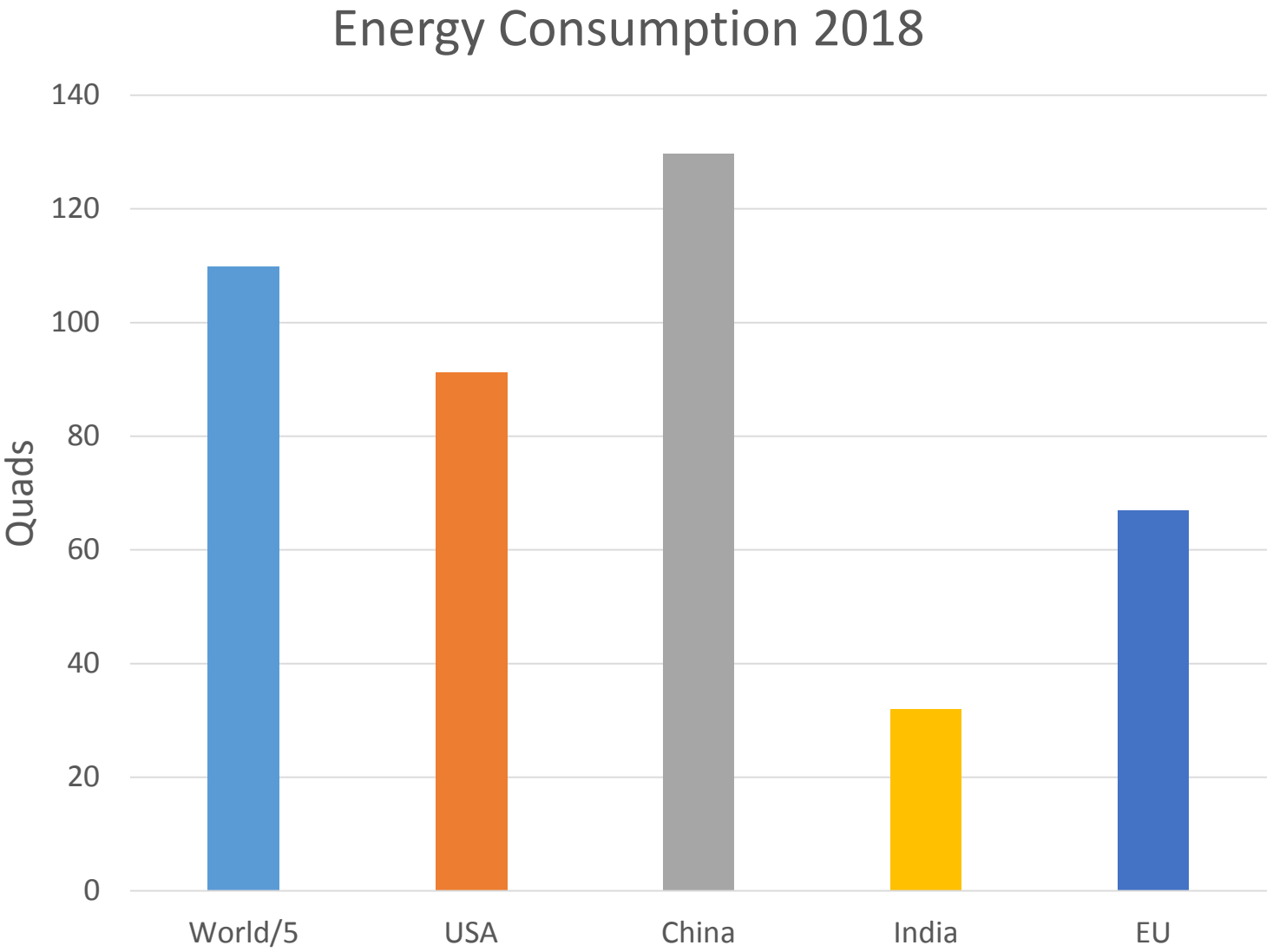


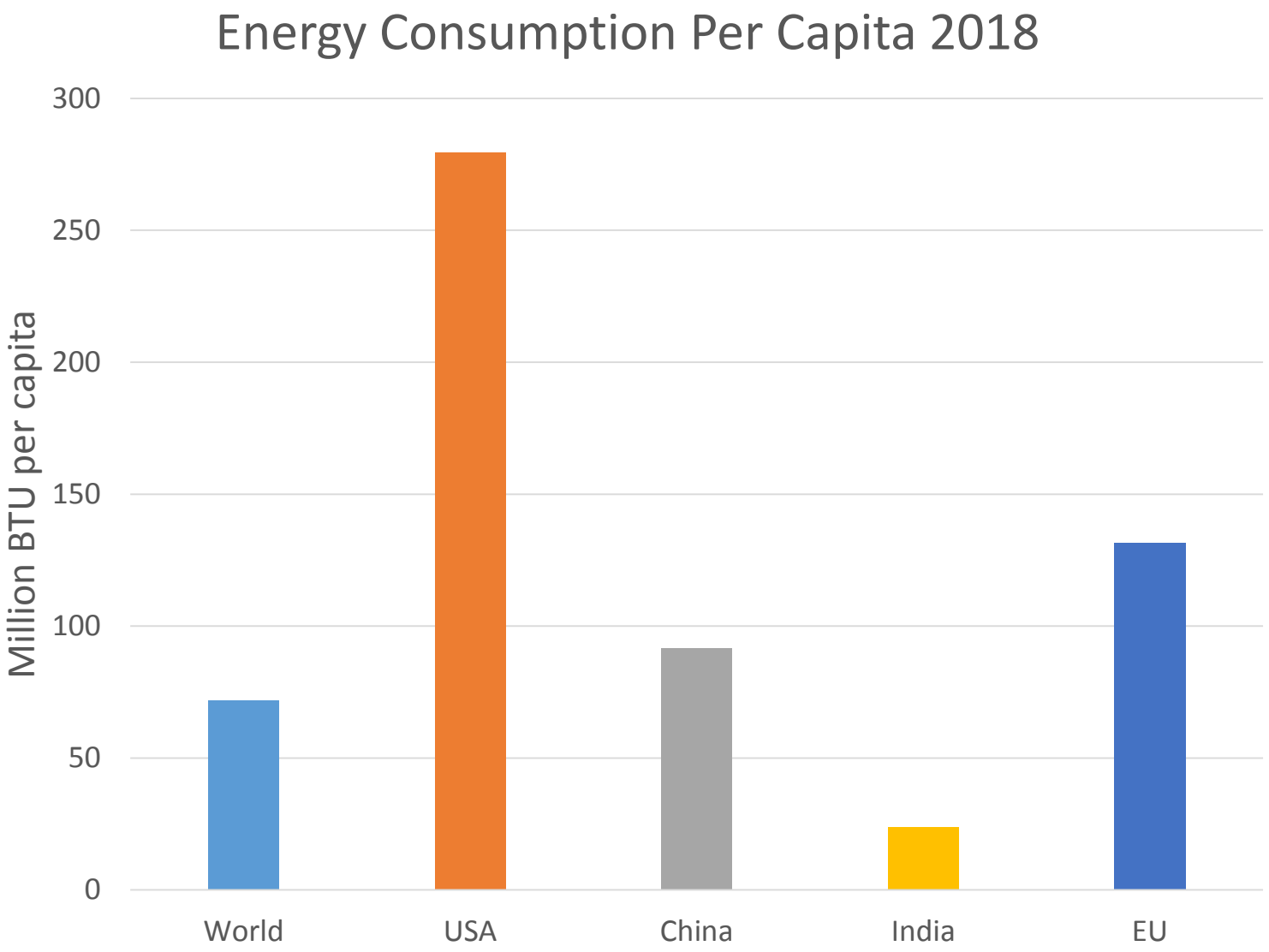

Economic Output (GDP) 2018
Trillions of 2018 US$
25
20
15
10
5
0
World/5
USA
China
India
EU

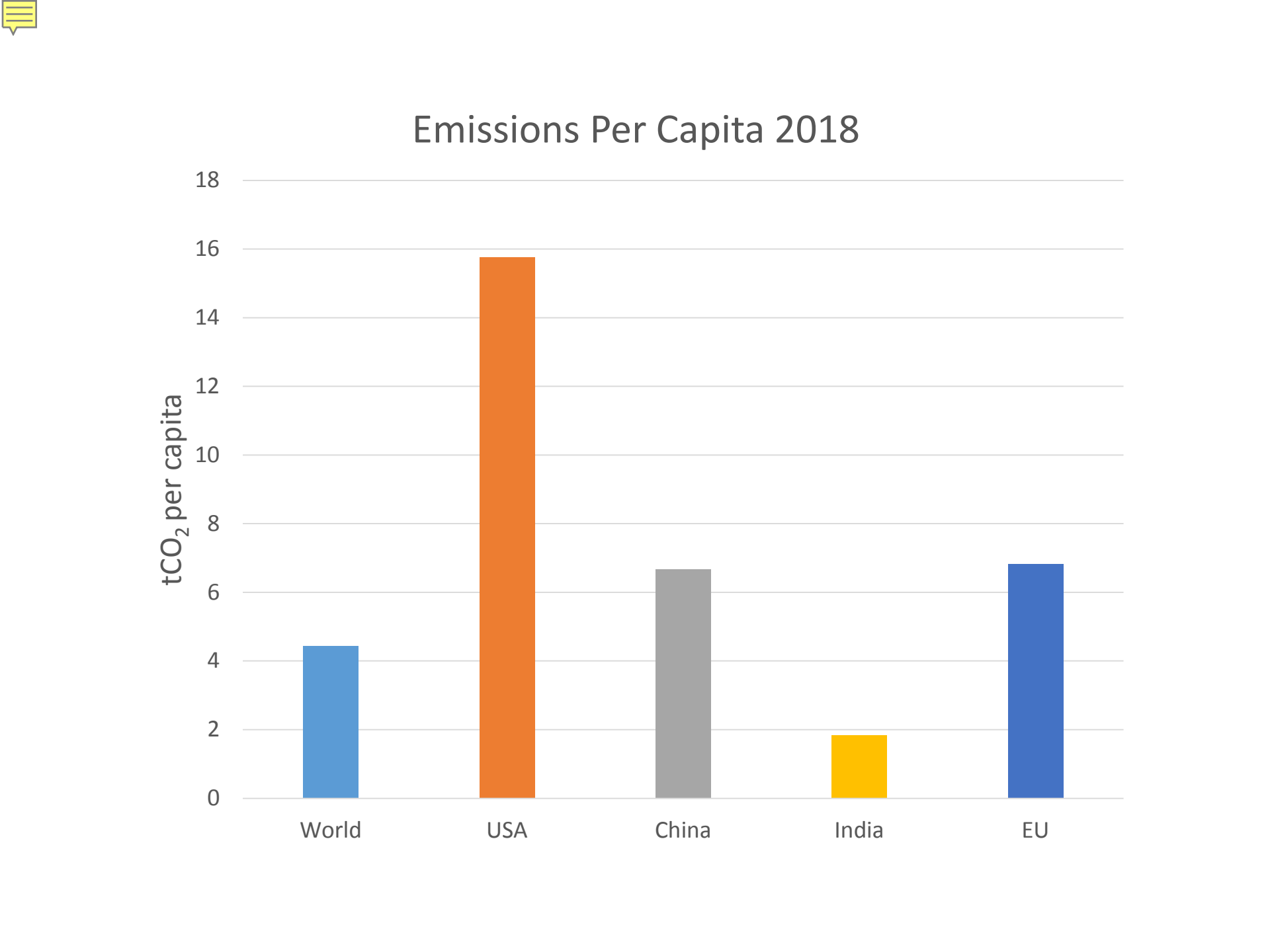
g = Consumption per person

$$\left(\frac{\text{Gross world product}}{\text{Population}}\right)$$



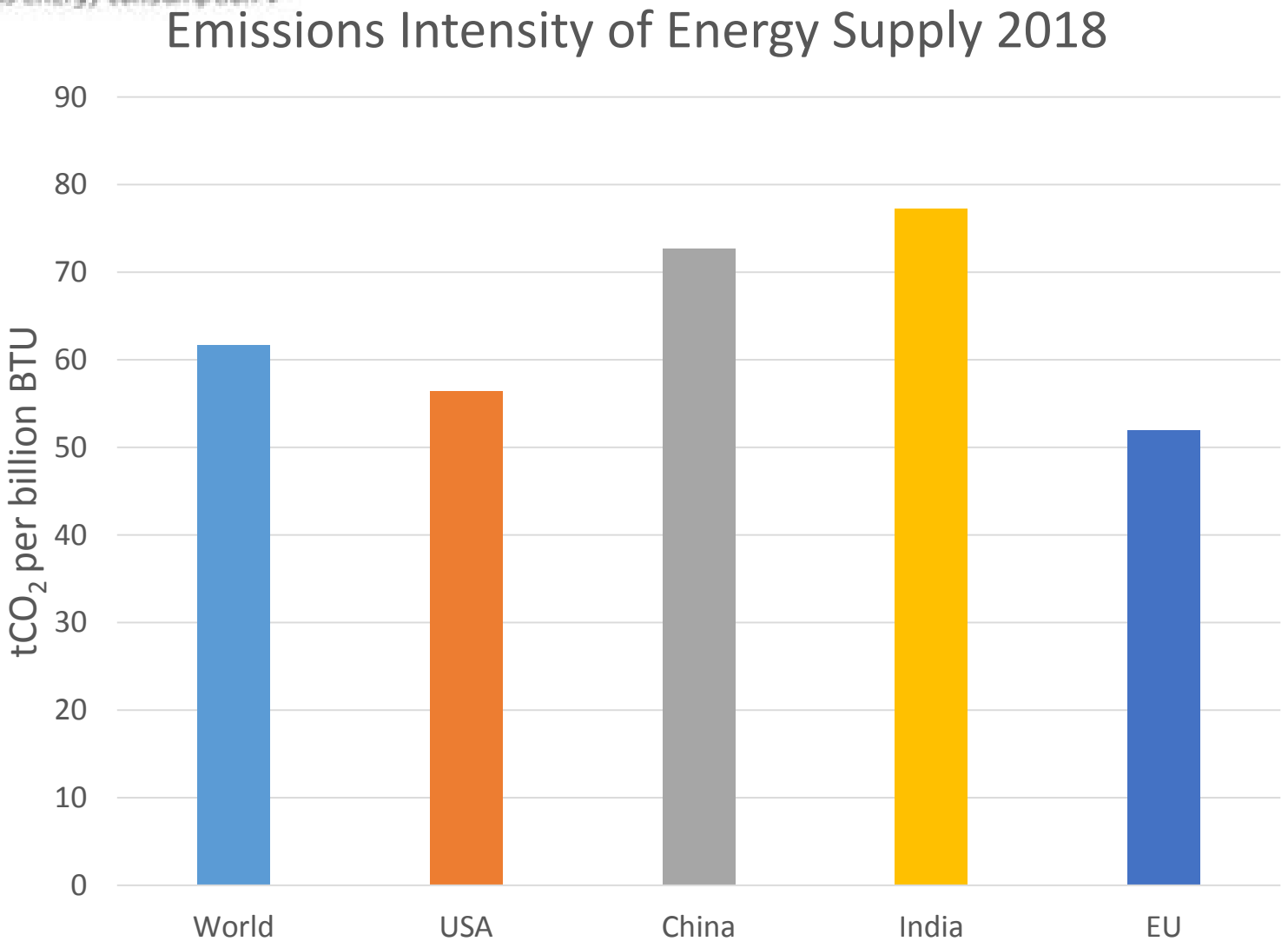

Energy Consumption 2018
Quads
140
120
100
80
60
40
20
0
World/5
USA
China
India
EU


Energy Consumption Per Capita 2018
Million BTU per capita
300
250
200
150
100
50
0
World
USA
China
India
EU


Emissions Per Capita 2018
18
16
14
12
10
8
6
4
2
0
tCO2 per capita
World
USA
China
India
EU

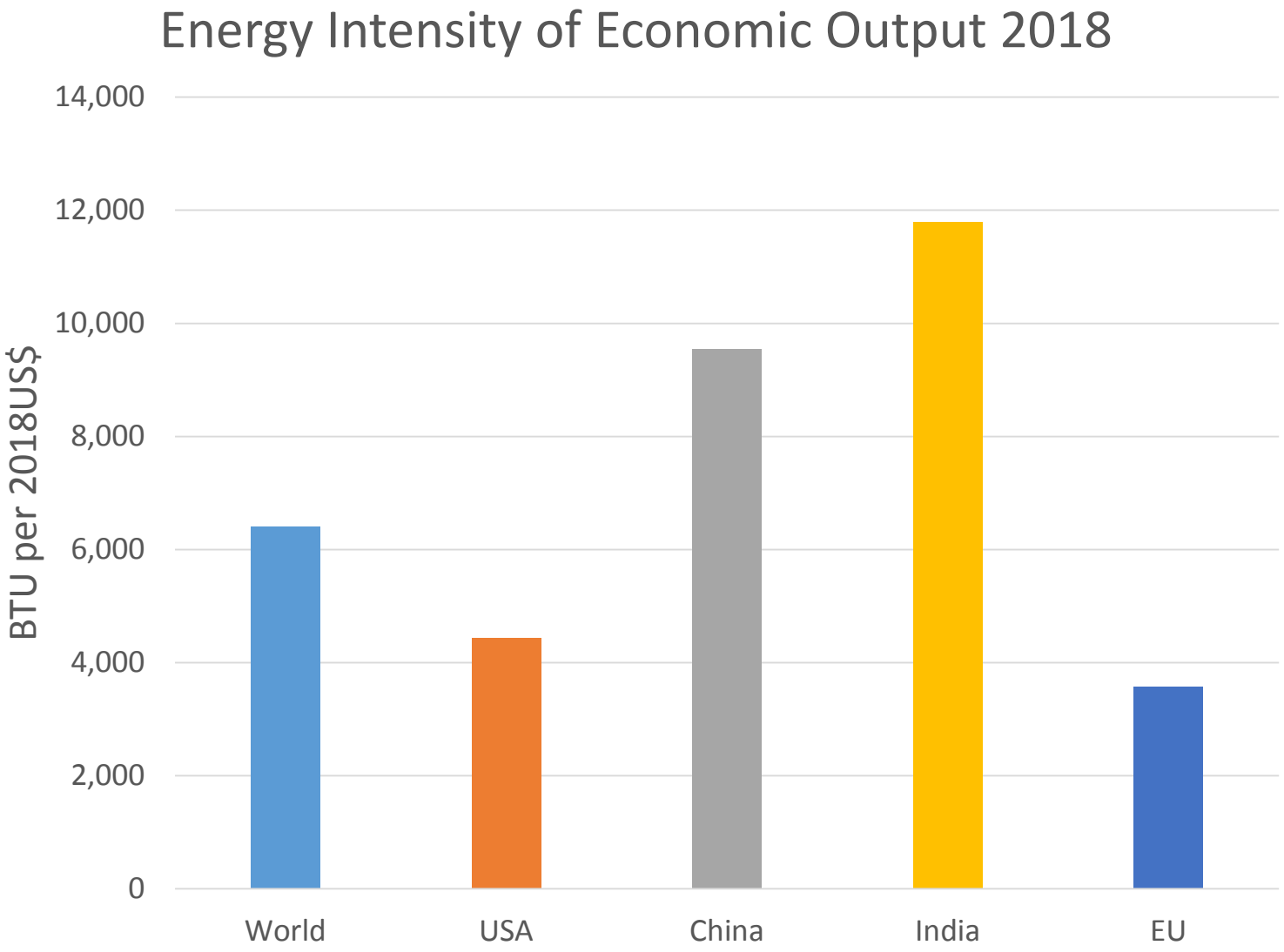
f = Total carbon used to make energy

$$\left(\frac{\text{Global } CO_2 \text{ emissions}}{\text{Gross energy consumption}}\right)$$



e = Energy intensity of gross world product

$$\left(\frac{\text{Gross energy consumption}}{\text{Gross world product}}\right)$$

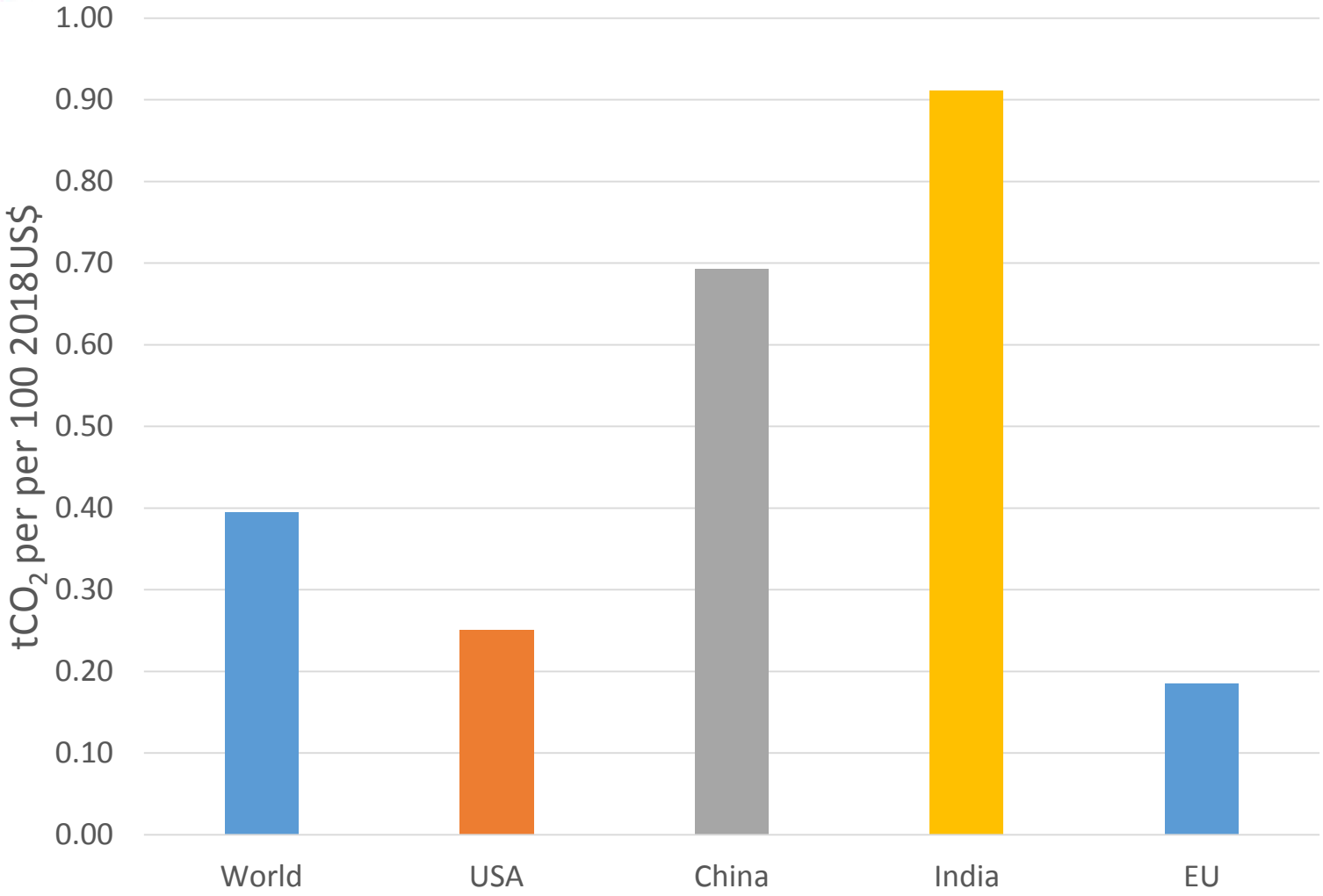


e = Energy intensity of gross world product

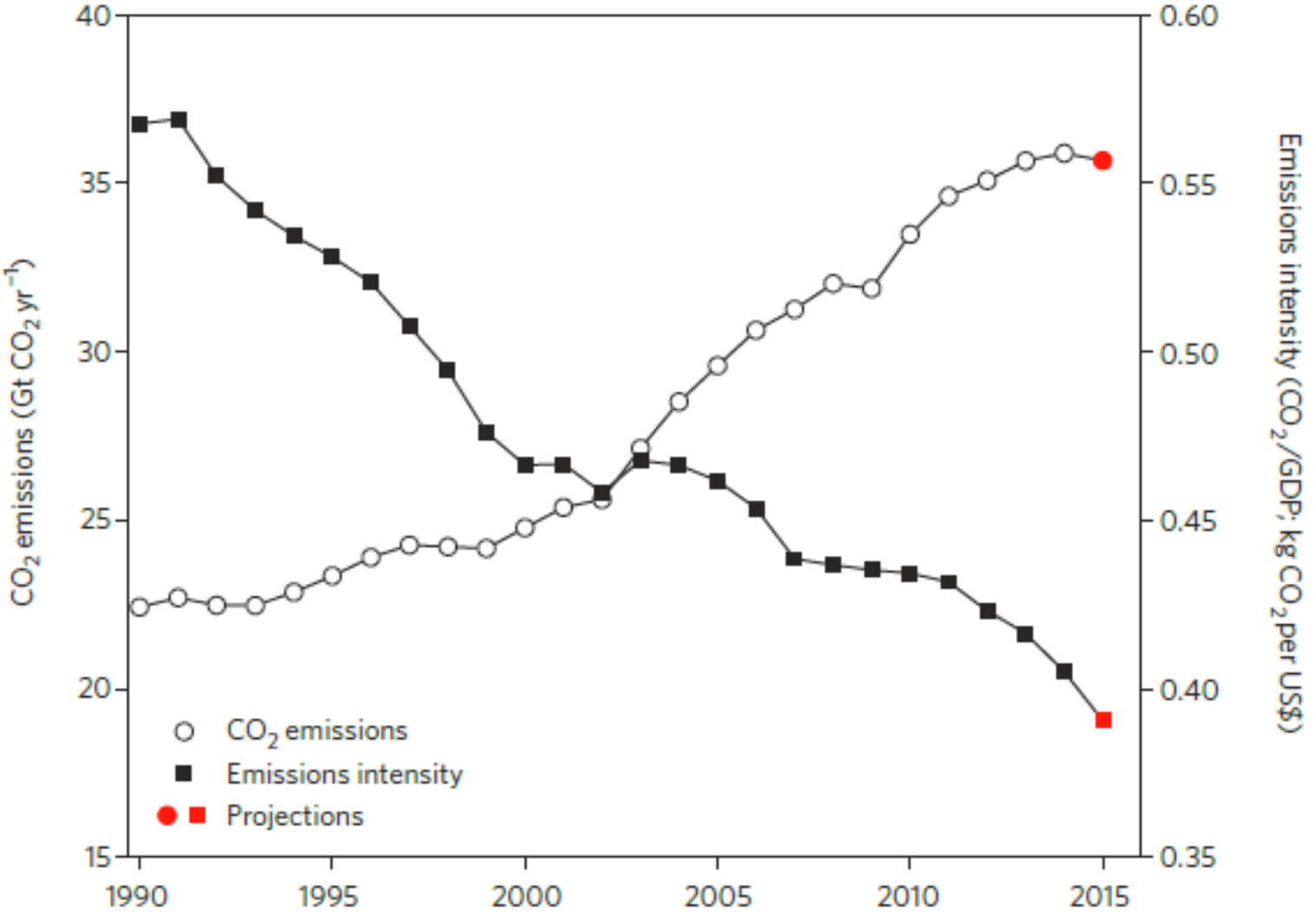
f = Total carbon used to make energy

$$\left(\frac{\text{Gross energy consumption}}{\text{Gross world product}}\right) \left(\frac{\text{Global } CO_2 \text{ emissons}}{\text{Gross energy consumption}}\right)$$

Emissions Intensity of Economic Output 2018



Global Emissions and Emissions Intensity 1990-2015



Kaya Take Away Thoughts, I

- China, U.S. and Europe are major emitters of CO_2
- China and India population twice or three times that of U.S. and Europe
- U.S. and Europe are major economies, China is growing
- U.S. and Europe GDP per capita much greater than that of China

Kaya Take Away Thoughts, II

- U.S., Europe, and China energy consumption roughly equal, but China will grow
- U.S. energy consumption and emissions per capita twice that of Europe
- All regions have similar emissions per unit of energy consumption, since all use fossil fuels
- China and India energy consumption and emissions per unit of economic output twice that of U.S. and Europe

International Efforts on Climate Change and Energy Policy

United Nations Framework Convention on Climate Change (UNFCCC) Article 2

ARTICLE 2

OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

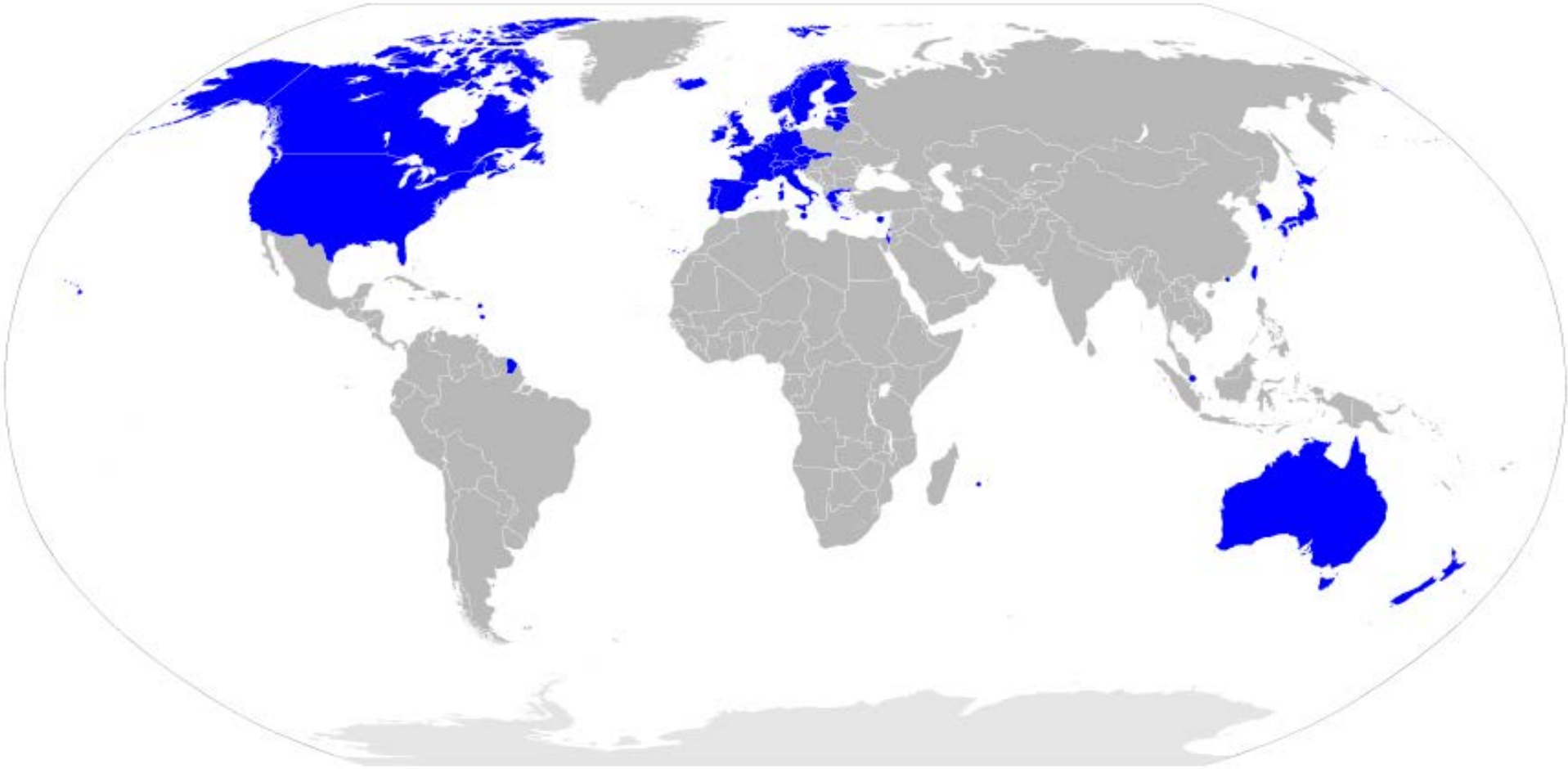
United Nations Framework Convention on Climate Change

- Negotiated in 1992 at Rio Conference “The Earth Summit”
- Ratified by all 197 members of U.N.
- Annual meetings since 1995: Conferences of the Parties [COP]
- 1997 Kyoto Protocol emission reductions agreement (COP-3)
- 2009 Copenhagen 2°C temperature rise limit goal agreement (COP-15)
- 2013 Warsaw (COP-19) Warsaw International Mechanism
- 2015 Paris (COP-21) November 30 – December 12, 2015
- 2016 Marrakech (COP-22) November 7 – 18, 201
- 2017 Bonn (COP-23) November 6 – 17, 2017
- 2018 Katowice (COP-24) December 3 – 14, 2018
- 2019 Madrid (COP-25) December 2 – 13, 2019

Kyoto Protocol
Article 3

The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B and in accordance with the provisions of this Article, with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012.

International Monetary Fund
Advanced Economies



Kyoto Protocol Timeline

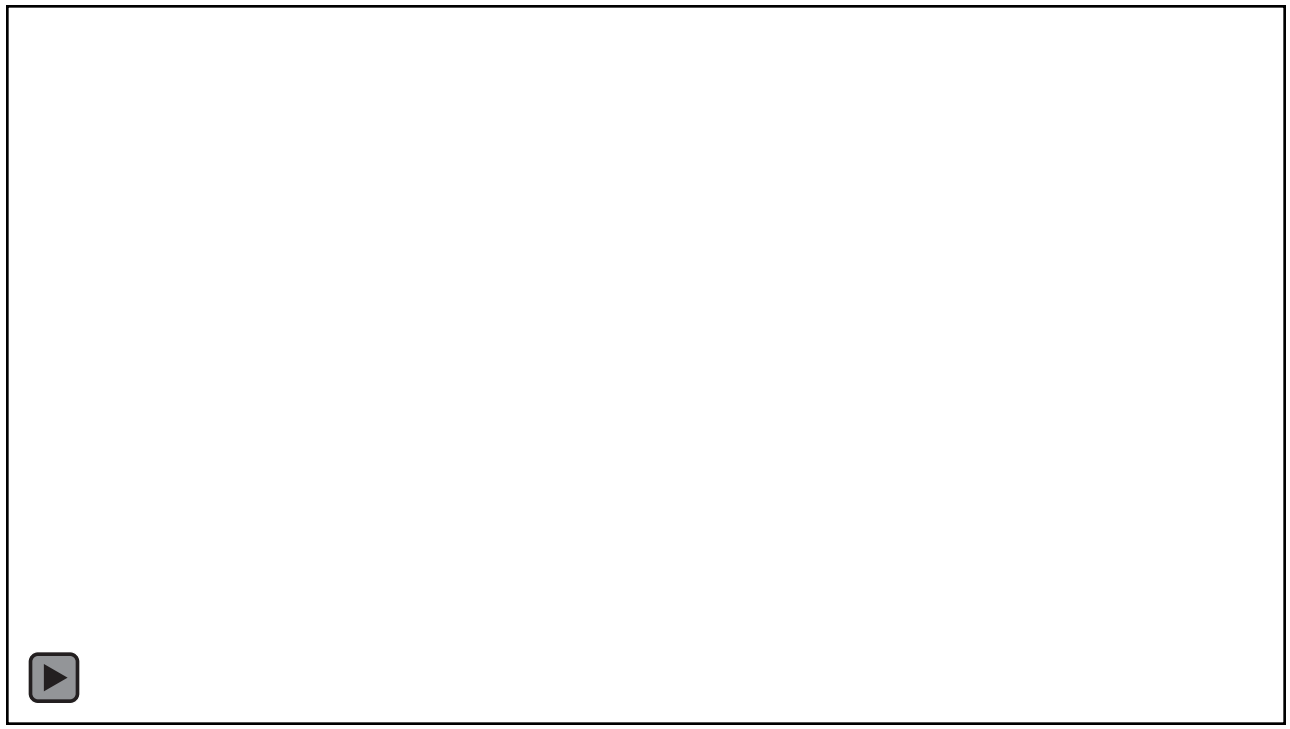
- U.S. Senate adopts Byrd-Hagel Resolution on July 7, 1997
- Adopted at COP-3 in Kyoto on December 11, 1997
- One year signature period opened on March 16, 1998
- 82 countries and European Community sign in one year
- U.S. signs on November 17, 1998
- Clinton administration does not submit Protocol to Senate
- Ratification opened on September 17, 1998
- 55% clause satisfied on November 18, 2004
- Protocol in force February 16, 2005
- Canada withdraws effective December 15, 2011
- By May, 2013 192 countries have ratified the Protocol
- U.S. signed, but did not ratify. Canada signed, ratified and withdrew.

President George W. Bush letter to Senators Hagel, Helms, Craig and Roberts March 13, 2001

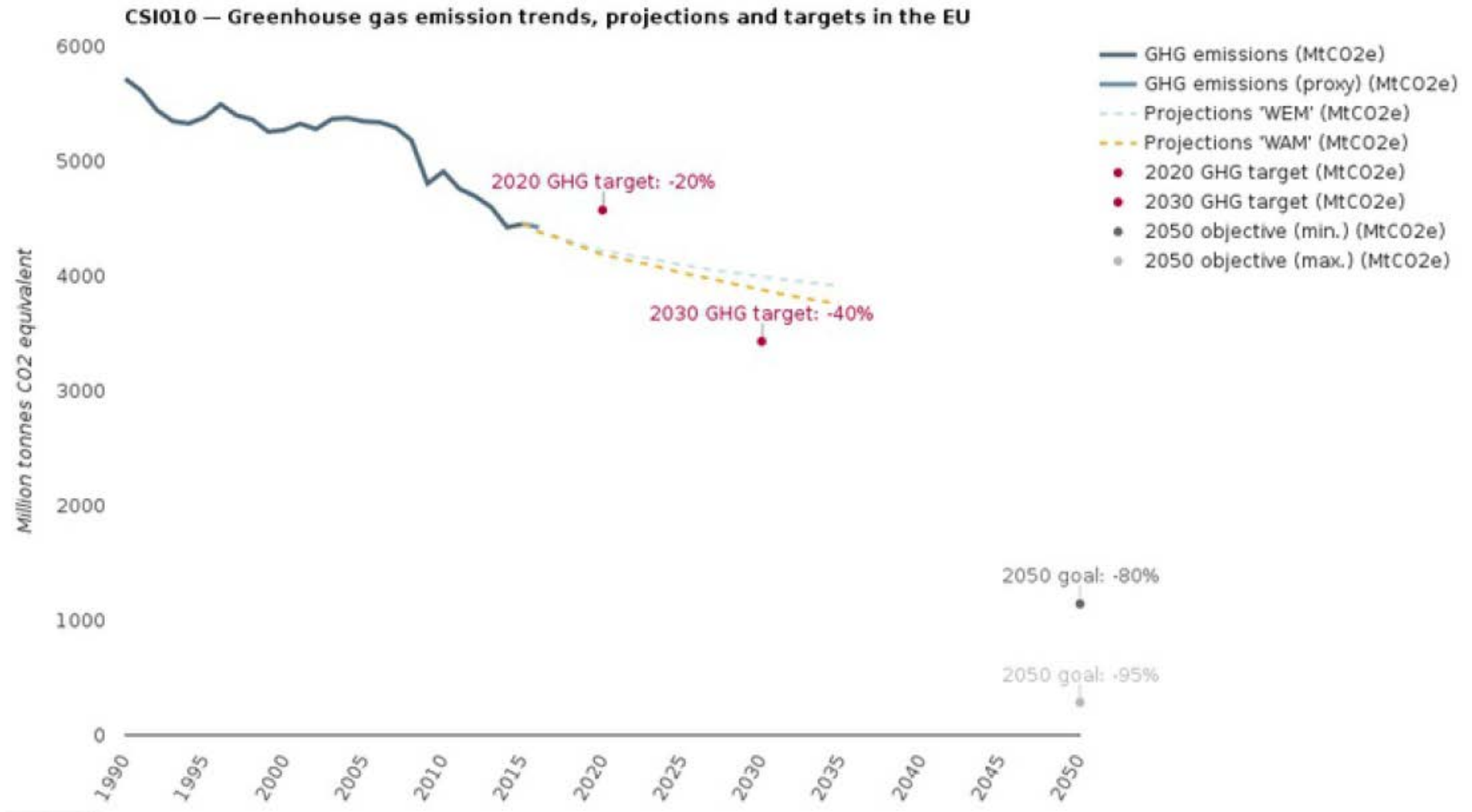
"As you know, I oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy. The Senate's vote, 95-0, shows that there is a clear consensus that the Kyoto Protocol is an unfair and ineffective means of addressing global climate change concerns."


US President offers alternative to Kyoto accord
AP
Pause (k)
AP

President Bush Kyoto Protocol



EU GHG Emissions History and Projections



Copenhagen Climate Conference

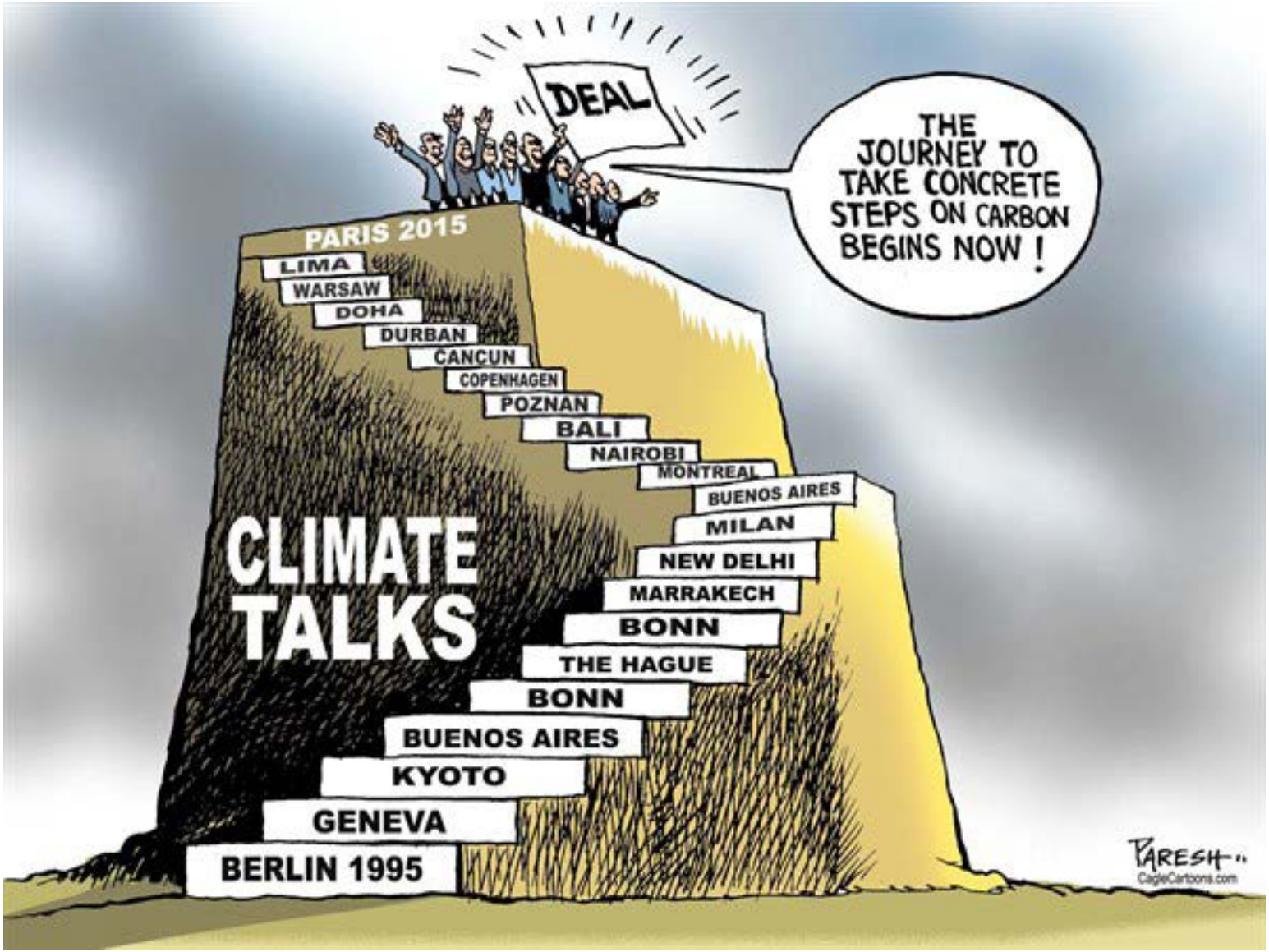
Copenhagen

- Goal was successor agreement to Kyoto
- Highly contentious meeting
  - Legally binding controversy
  - Financial responsibility of developed nations
  - Commitment of developing nations, especially China and India
  - Concerns of poorest nations
- Accord drafted by only a small circle of countries
- Some positive basis for future conferences: Green Climate Fund

Progression of Intergovernmental Panel on Climate Change [IPCC] Summary Statements

- FAR: “The unequivocal detection of the enhanced greenhouse effect…is not likely for a decade or more.”
- SAR: “The balance of evidence suggests that there is a discernible human influence on global climate.”
- TAR: “most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.”
- AR4: “Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.”
- AR5: “It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.”

HFCCC COP Meetings to COP-21



HFCCC COP Meetings and IPCC Reports

IPCC Fifth Report 2014

IPCC Fourth Report 2007

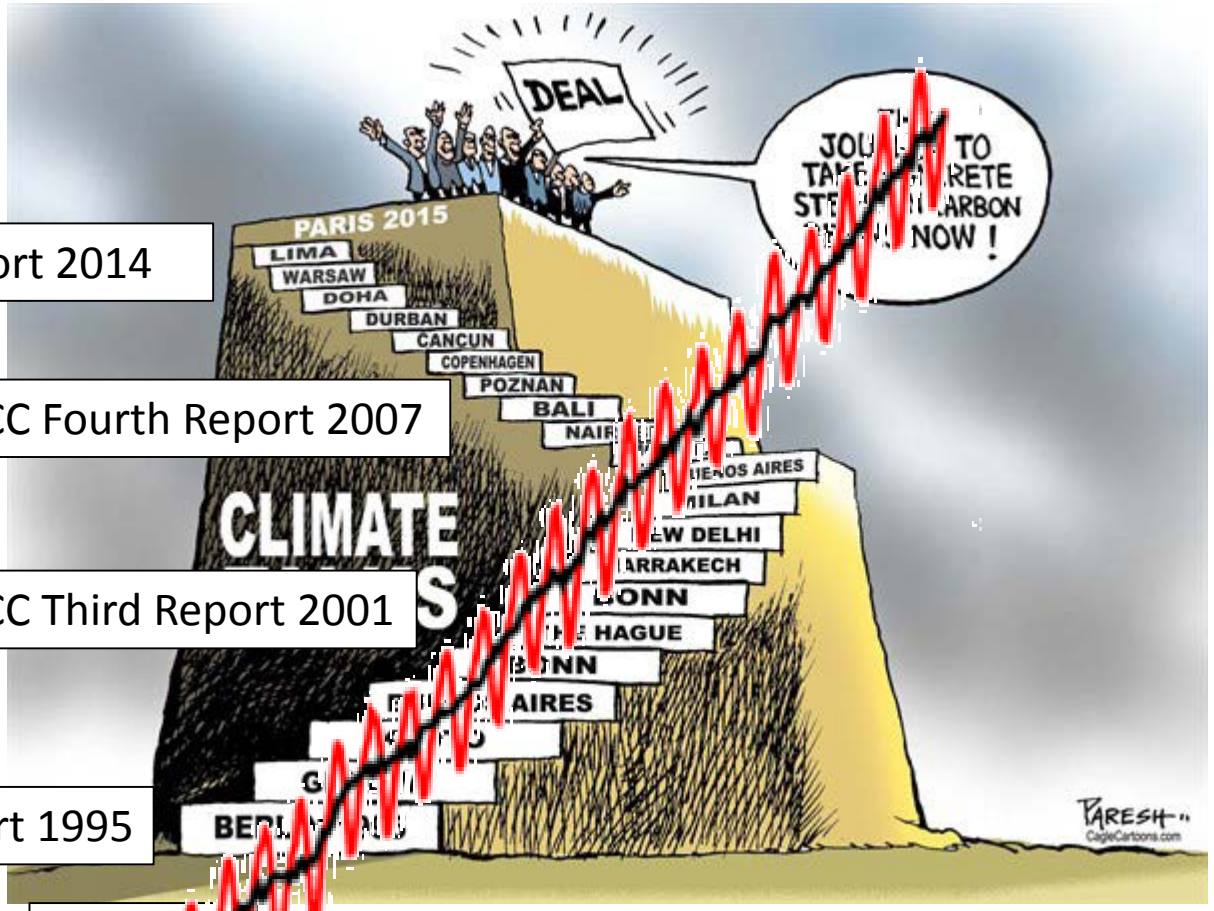
IPCC Third Report 2001

IPCC Second Report 1995

RIO 1992

IPCC First Report 1990

UNFCCC History and Keeling Curve



IPCC Fifth Report 2014

IPCC Fourth Report 2007

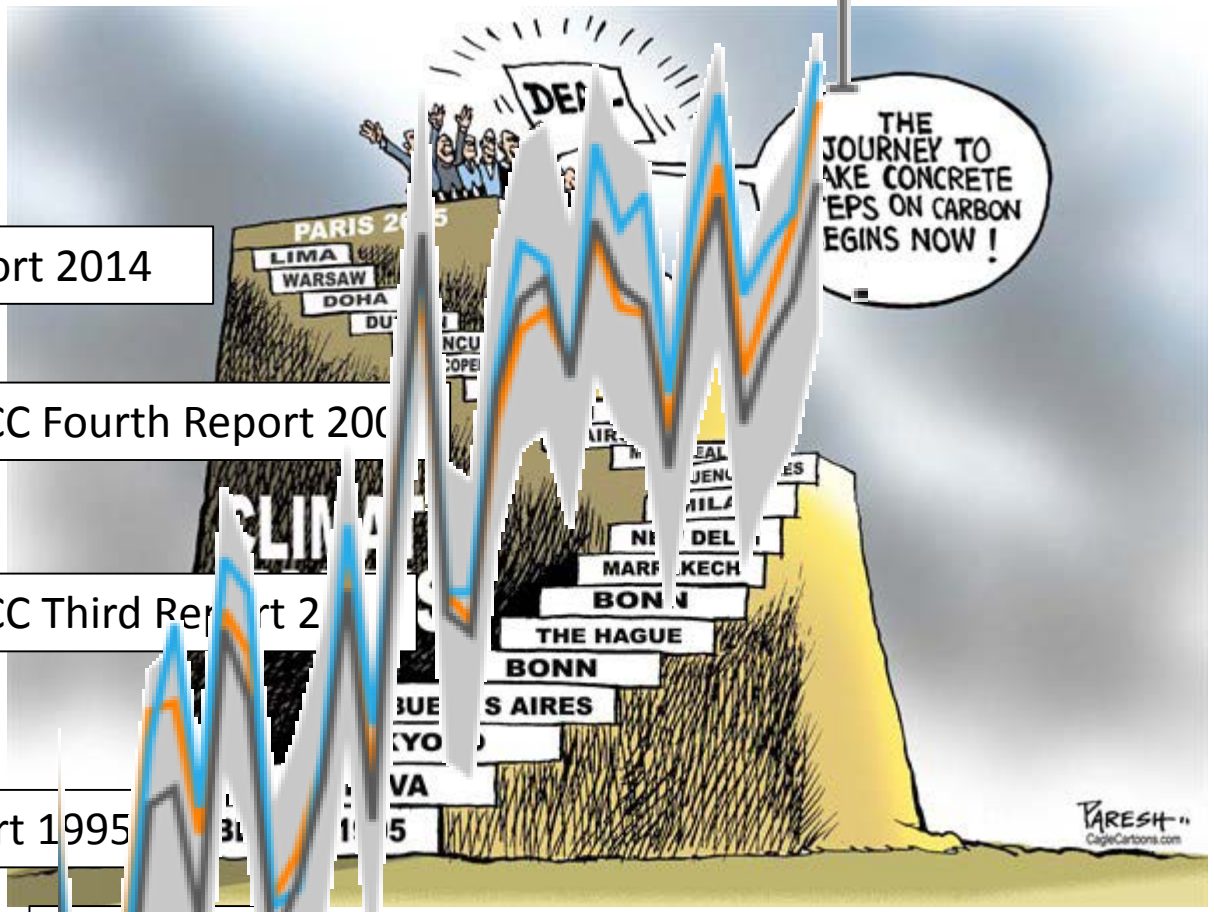
IPCC Third Report 2001

IPCC Second Report 1995

RIO 19

IPCC First Report 1990

UNFCCC History and Global Temperature




RISING SEA LEVELS
12/15
DARKOW
2015
COLUMBIA DAILY TRIBUNE
DARKOWCARTOONS
2015
PARIS
CLIMATE
PACT
PURELY VOLUNTARY
AND DEPENDENT
ON THE HONOR SYSTEM
2009
COPENHAGEN
CLIMATE
CHANGE
CONFERENCE
1992
KYOTO
PROTOCOL

Voluntary versus legally binding agreement

- Agreements entered into by sovereign states
- Sovereign state must execute some domestic actions
- Sovereign state must consent to enforcement
- No climate agreement has had enforcement mechanisms similar to WTO
- Sovereign states act for political reasons: self-interest, public pressure, reputation, bargain position

Why Are They Doing This?

Christiana Figueres:
Why are they doing this [agreeing to their pledges]? Frankly, none of them are doing it to save the planet. Let me be *very clear*. They're doing it for what I think is a much more powerful political driving force, which is for the benefit of their own economy.

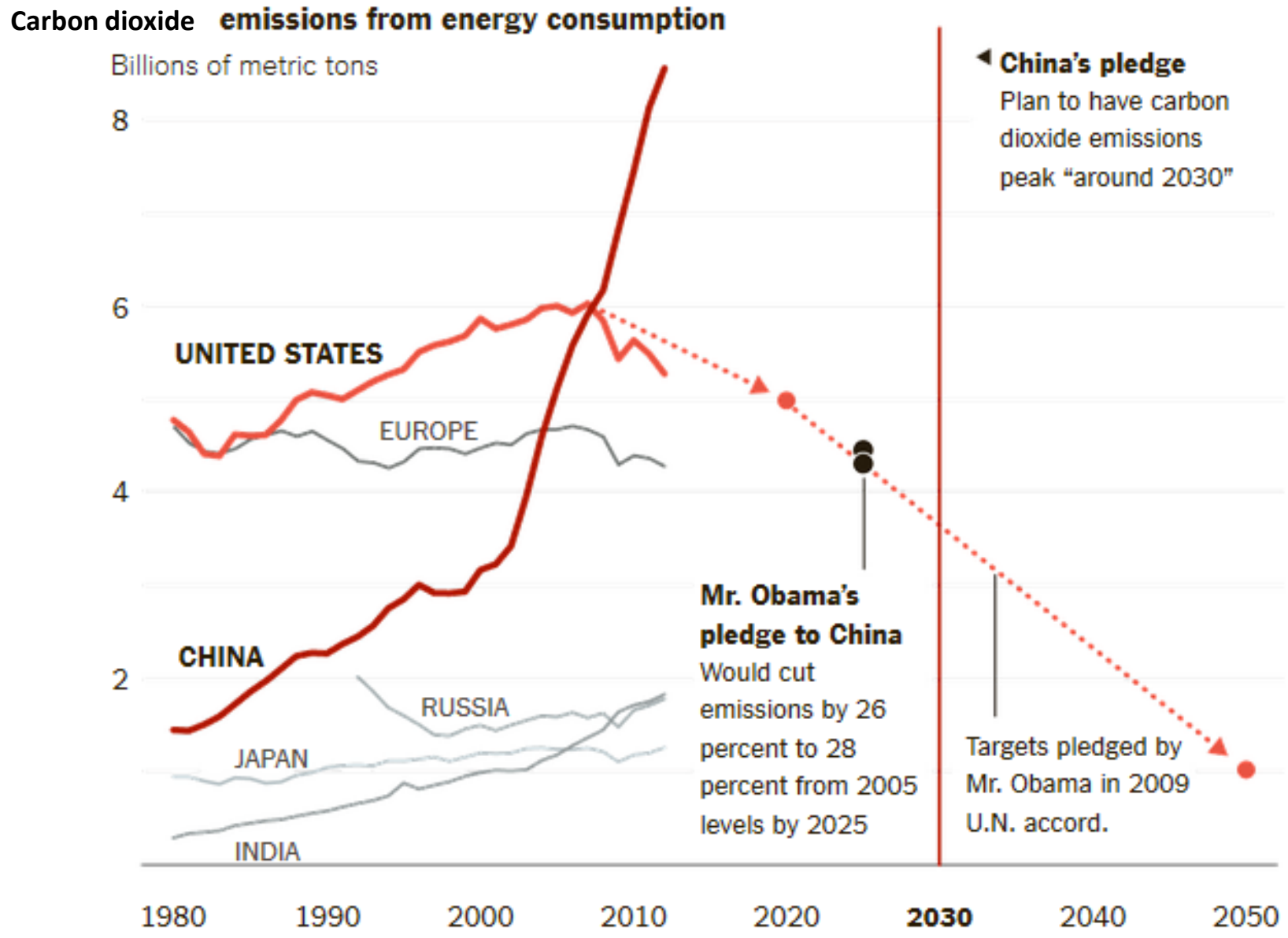
Paris Conference (COP-21)

The New York Times

November 12, 2014

U.S. and China Reach Climate Accord After Months of Talks

U. S. - China Announcement November 12, 2014



Paris Agreement: Key Points

- 165 countries declare specific emission plans (Intended Nationally Determined Contributions) through 2020 and beyond
- Emission plans will be reviewed every five years starting in 2018
- Reporting on emissions required every two years subject to technical review
- Green Climate Fund of $100 billion by 2020 and then $100 billion annually to 2025

The New York Times

January 20, 2017
With Trump in Charge, Climate Change References Purged From Website

THE WALL STREET JOURNAL.

January 22, 2017
Trump Administration Aims to Reverse Obama's Climate Agenda

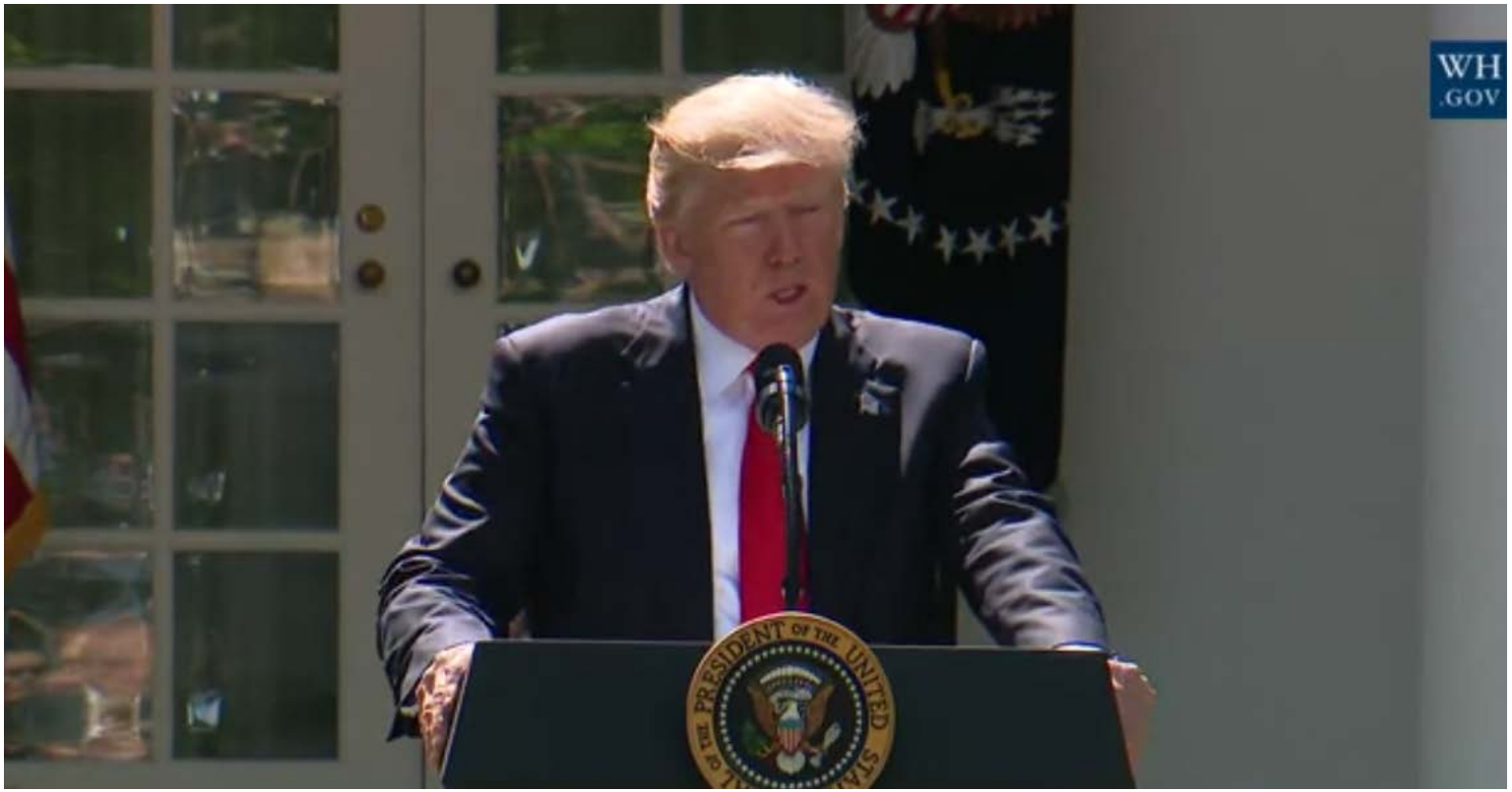
ThinkProgress

January 17, 2017

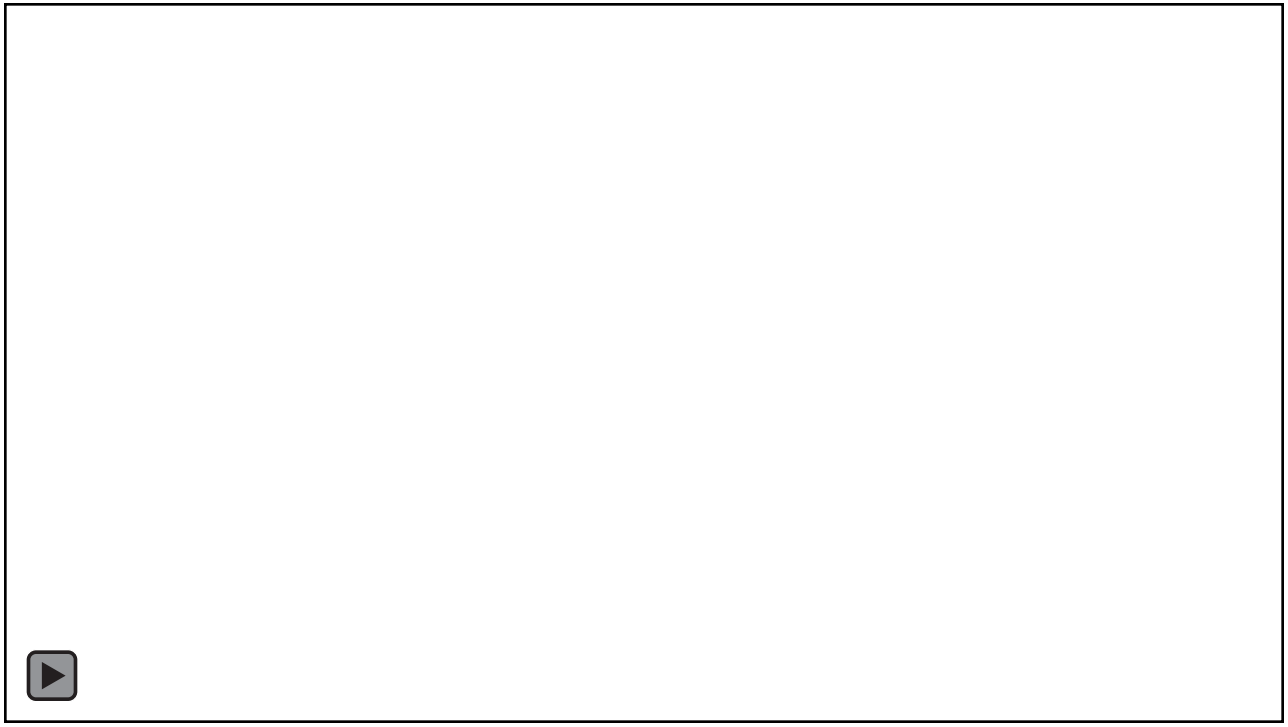
China makes it clear they are ready to lead on climate if Donald Trump won't

"The Paris agreement is a hard-won achievement… all signatories should stick to it rather than walk away,"

June 1, 2017 President Trump Announces that United State Will Withdraw from Paris Agreement



President Trump Paris Agreement



Paris Agreement: Key Phrases

- “Well below 2°C”
- “Achieve a balance” between sources and sinks
- “Every 5 years”
- “Technology development”
- “Mobilizing climate finance”
- “Enhanced transparency”
- “Loss and damage”
- “55%”

"Well below 2°C" At the 2009 Copenhagen climate meeting, countries agreed on a target of keeping temperatures to no more than 2°C above preindustrial levels. In Paris, countries calling themselves the "most vulnerable"—such as Pacific island nations—pressed for a goal of 1.5°C. They almost got there. The agreement aims at "well below" 2°C, and a promise to "pursue efforts" to cap the warming at 1.5°C.

"Achieve a balance" The deal calls for the rise in atmospheric greenhouse gas concentrations to effectively stop in the second half of the century. At that point, any further emissions would need to be canceled out with "sinks" such as expanding forests that suck up carbon dioxide.

"Every 5 years" Countries are expected to submit new, more ambitious plans every 5 years, beginning in 2020, rather than every 10 years as some major emitters including India reportedly wanted.

"Technology development" The deal emphasizes the importance of developing and spreading new low-emissions technology. At the conference, 20 countries including the United States, China, and a number of European countries vowed to double clean energy R&D spending over 5 years. A private initiative headlined by Microsoft founder Bill Gates will also push for new technology.

"Mobilizing climate finance" Developed countries previously promised $100 billion per year in public and private funding to help developing countries adapt to climate change and build low-carbon economies. In Paris, some developing countries pushed for a legally binding commitment. The deal says the richest countries will set a new funding target by 2025. But the details are in the subsidiary text, not the actual agreement.

"Enhanced transparency" All countries will have to submit regular inventories of their emissions. The reports will have to meet certain accounting standards, and be subjected to "expert review."

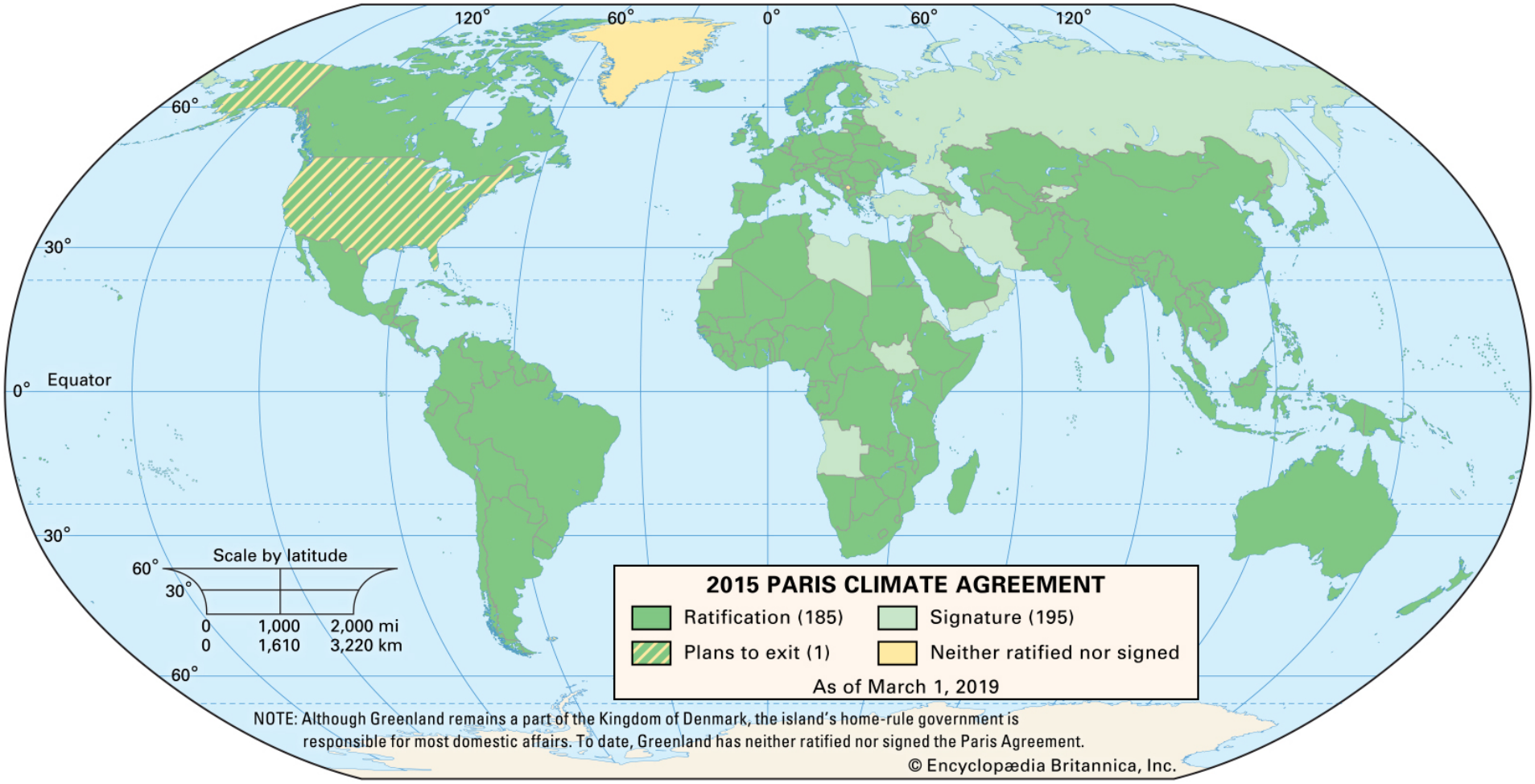
"Loss and damage" Poor countries most vulnerable to the impacts of climate change have pressed for developed countries to recognize their losses, and acknowledge legal responsibility. They got the recognition. But the final agreement cautions that it "does not involve or provide a basis for any liability or compensation."

"55%" Although delegates from all nations attending the conference agreed to the deal, it won't take effect until after next April—and only if at least 55 countries representing at least 55% of global greenhouse gas emissions have formally signed it. ■

–W. C.

Paris Agreement Status

Paris Agreement Status March, 2019

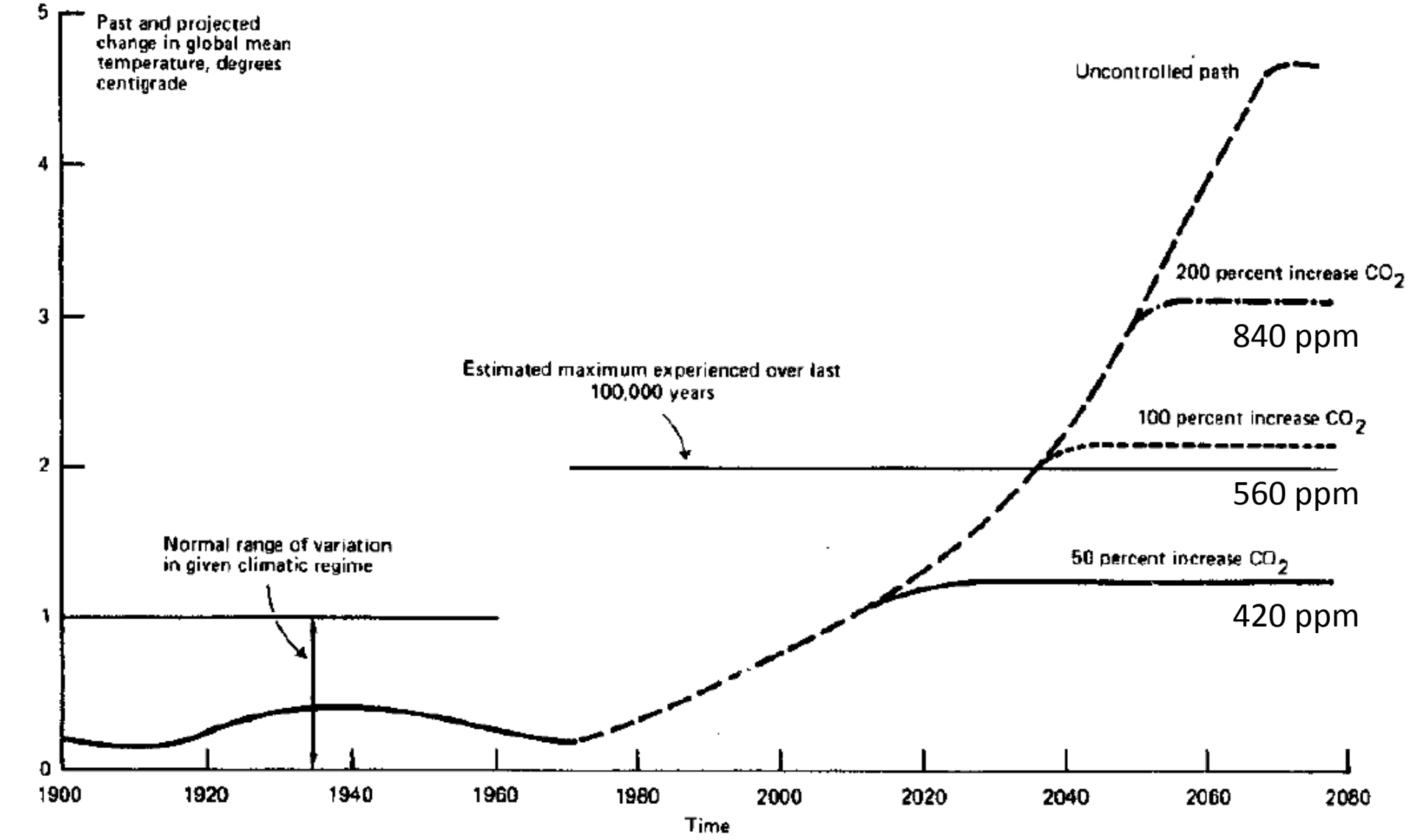


Two Degree Limit

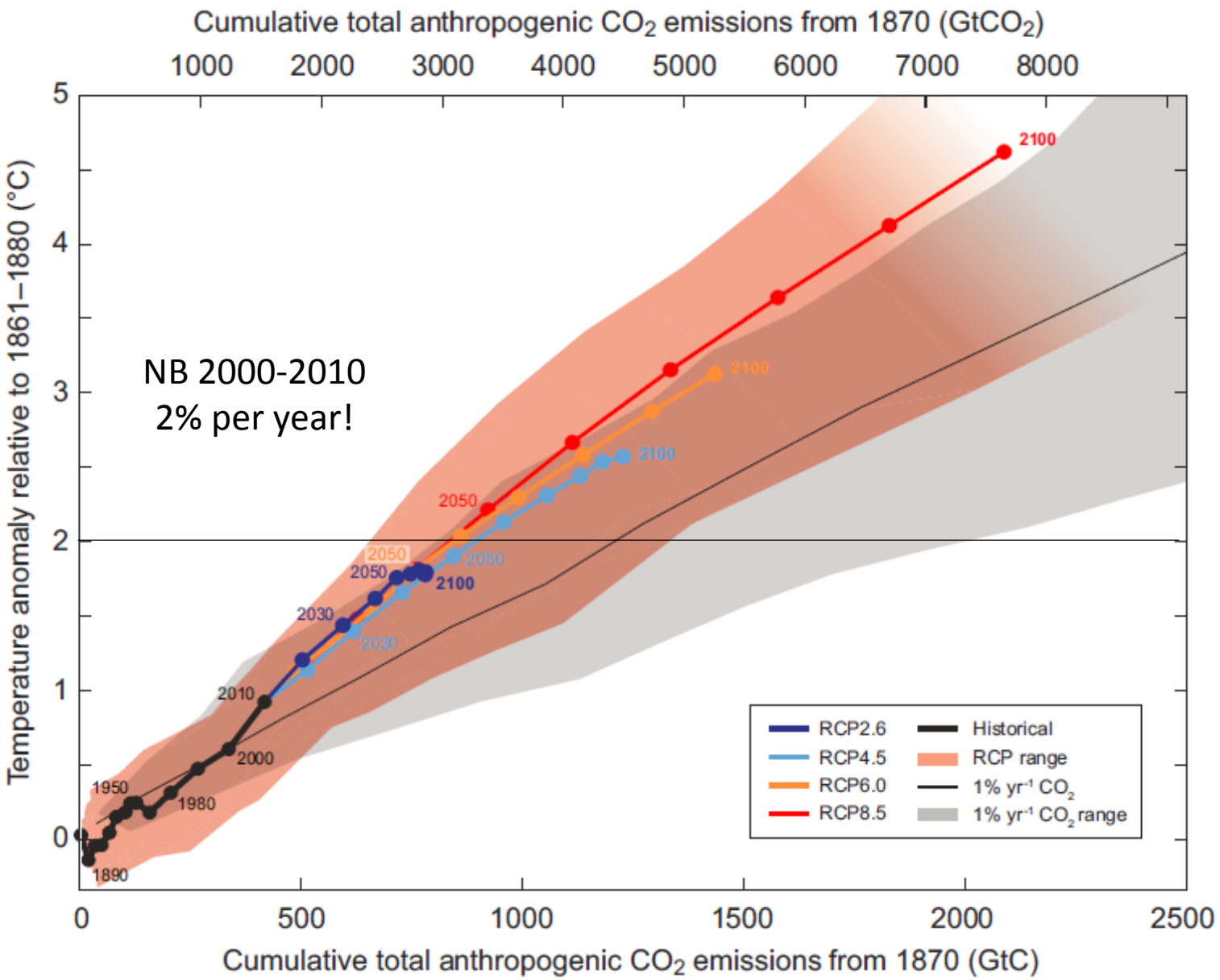
Two Degree Limit
William D. Nordhaus
"Can We Control Carbon Dioxide?" 1975

"As a first approximation, it seems reasonable to argue that the climatic effects of carbon dioxide should be kept within the normal range of long-term climatic variation. According to most sources the range of variation between distinct climatic regimes is in the order of ± 0.5°C, and at the present time the global climate is at the high end of this range. If there were global temperatures more than 2 or 3°C above the current average temperature, this would take the climate outside of the range of observations which have been made over the last several hundred thousand years."

Two Degree Limit
William D. Nordhaus
The Efficient Use of Energy Resources 1975



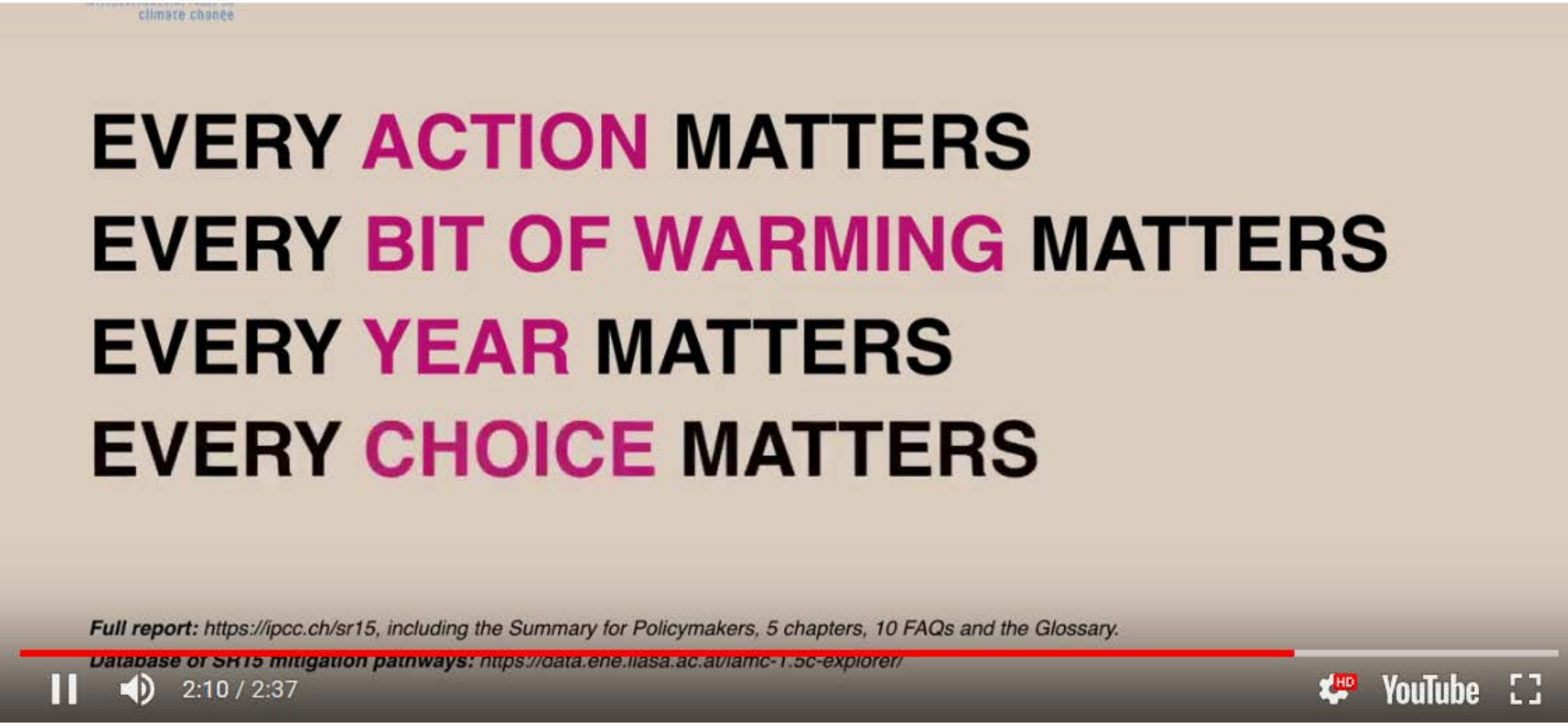
Total Emissions and Temperature



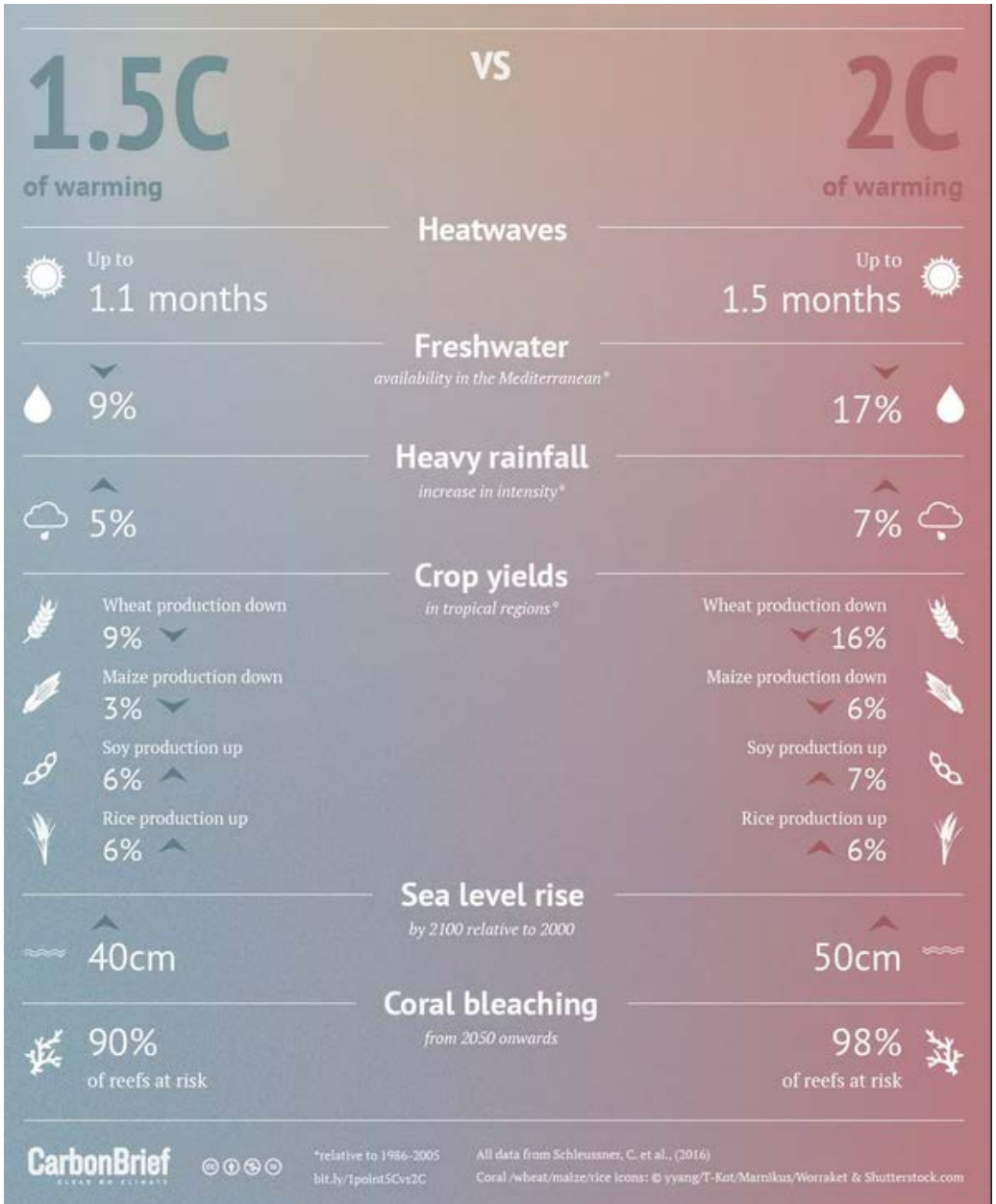
1.5 °C versus 2.0 °C

Global Warming of 1.5 °C
October 6, 2018

Global Warming of 1.5 °C
October 6, 2018



1.5 °C versus 2.0 °C



NDCs
Nationally Determined Contributions

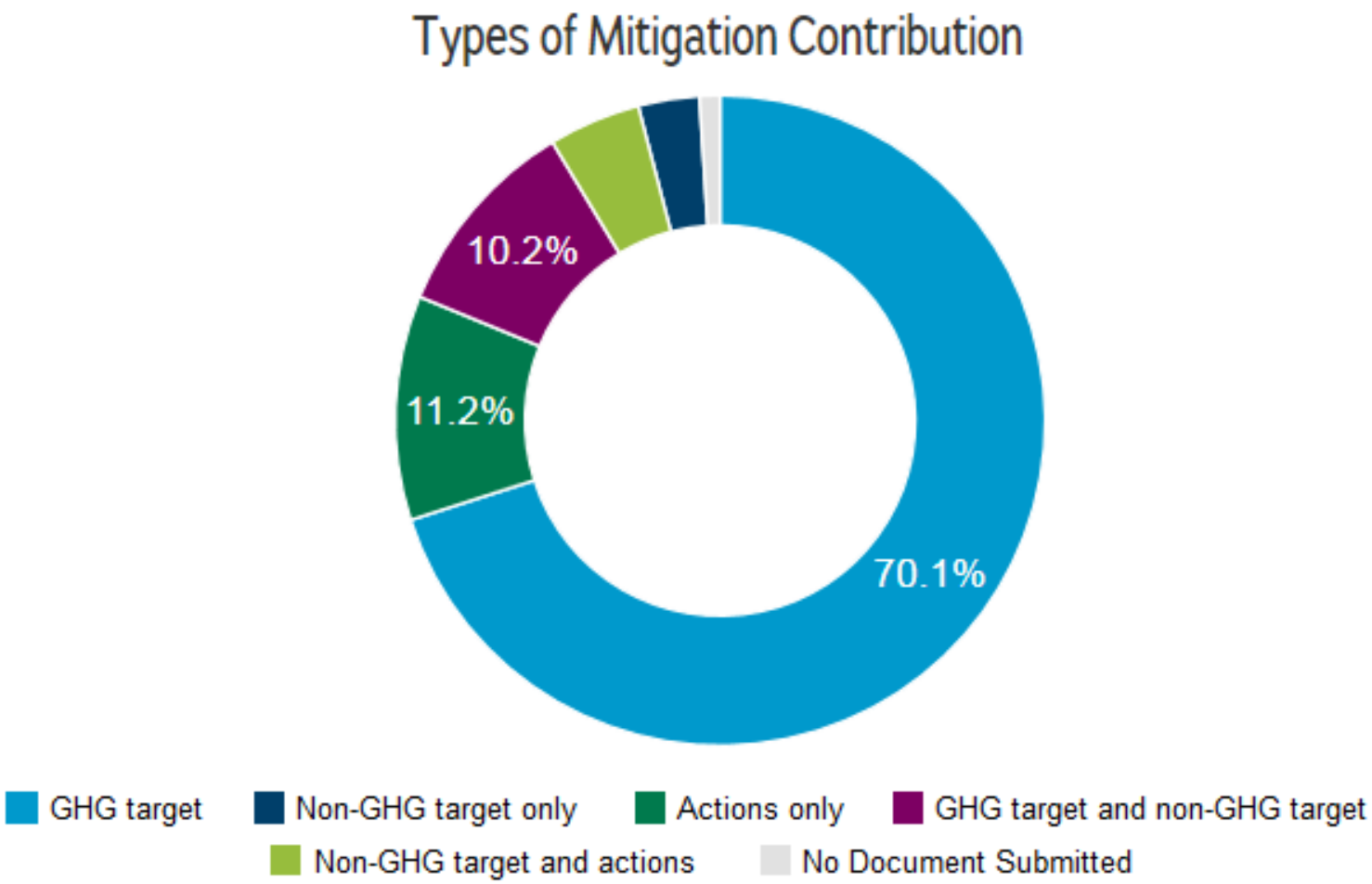
Current NDC Submission Status
May, 2019

165 INDCs submitted,
representing **192** countries

Global emissions covered by countries that submitted an INDC

96.4%

NDC Type


Types of Mitigation Contribution
10.2%
11.2%
70.1%
GHG target
Non-GHG target only
Actions only
GHG target and non-GHG target
Non-GHG target and actions
No Document Submitted

Paris Agreement Emission Targets (2015)

- China
  - Emissions to peak by 2030
  - 20% renewables by 2030
  - Reduce carbon intensity by 60-65% of 2005 levels by 2030
- U.S. reduce emission by 26-28% of 2005 levels by 2025
- EU reduce emission by at least 40% of 1990 levels by 2030
- India
  - Reduce carbon intensity by 33-35% of 2005 levels by 2030
  - 40% renewables by 2030
  - Sequester 2.5-3.0 GtCO2e by 2030
- Brazil
  - Reduce emission (including LULUCF) by 37% of 2005 by 2025
  - 45% renewables by 2030
- Russia reduce emissions by 25-30% of 1990 levels by 2030
- Japan reduce emissions by 26% of 2013 levels by 2030

CAT Climate Target Update Tracker

CLIMATE TARGETS
Status of the 2020 NDC update process

2 Countries have **submitted** new NDC targets

2 Countries have **proposed** new NDC targets

183 Countries have not updated targets

Last updated: 13 Dec 2019

The maps displayed are for reference only

0% GLOBAL EMISSIONS COVERED BY SUBMISSIONS

0% GLOBAL POPULATION COVERED BY SUBMISSIONS

COUNTRIES WE ANALYSE

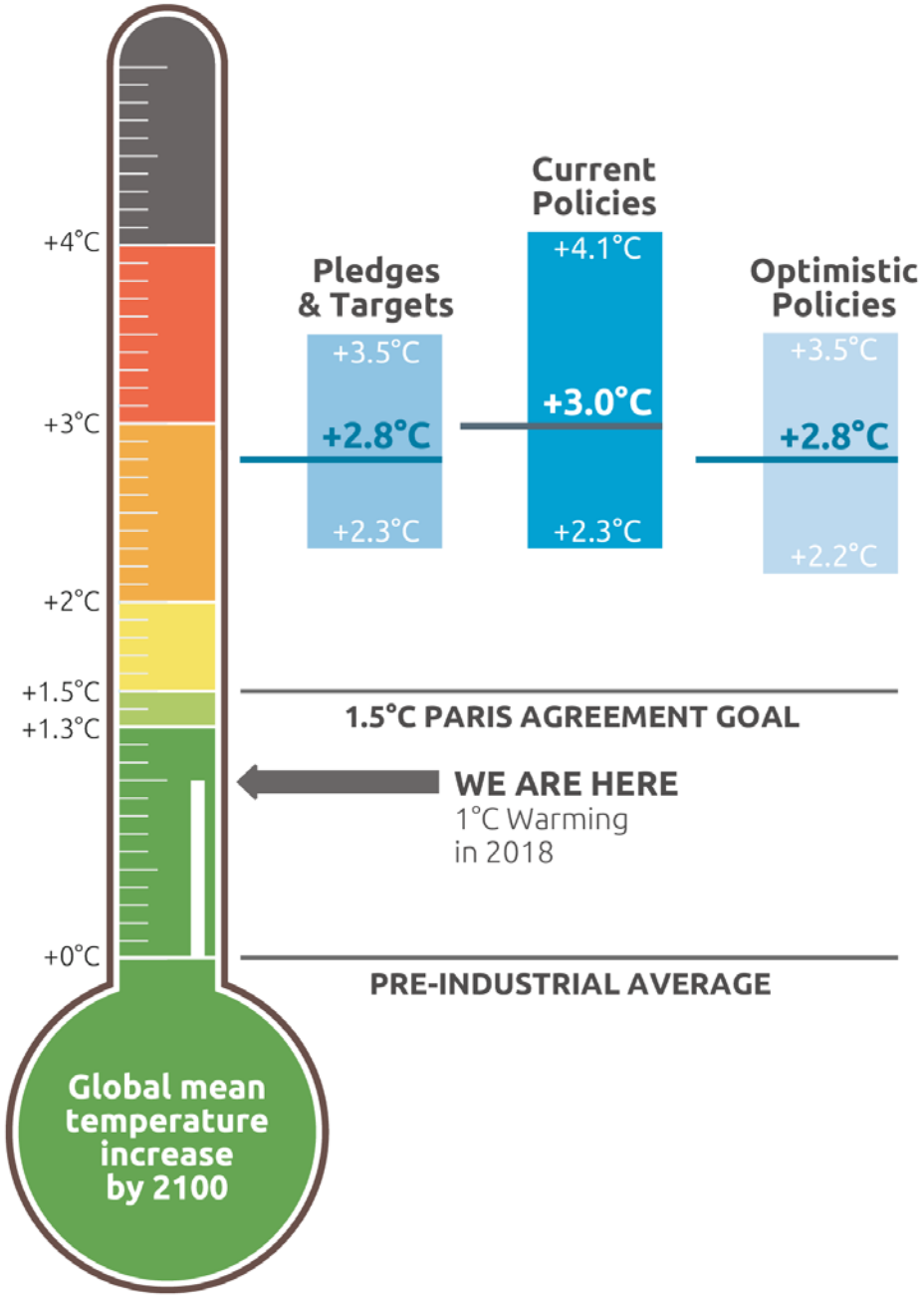
SUBMITTED A NEW TARGET	PROPOSED A NEW TARGET	WILL NOT UPDATE TARGET
-	CHILE	AUSTRALIA JAPAN USA

COUNTRIES WE DON'T ANALYSE

SUBMITTED A NEW TARGET	PROPOSED A NEW TARGET
MARSHALL ISLANDS SURINAME	MONGOLIA

CLIMATE ACTION TRACKER

Climate Action Tracker Ratings



Climate Action Tracker

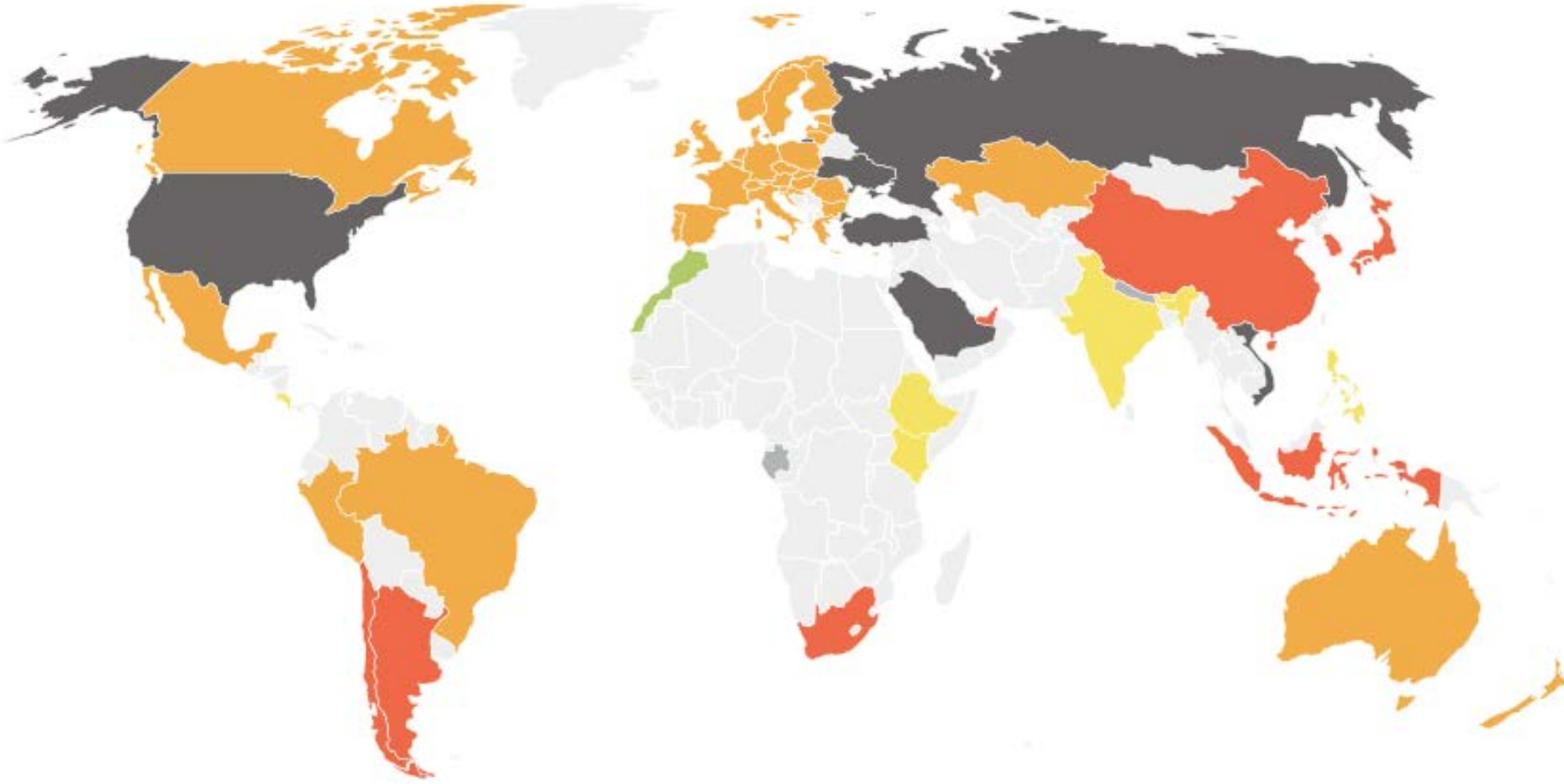
CAT warming projections

Global temperature increase by 2100

December 2019 Update

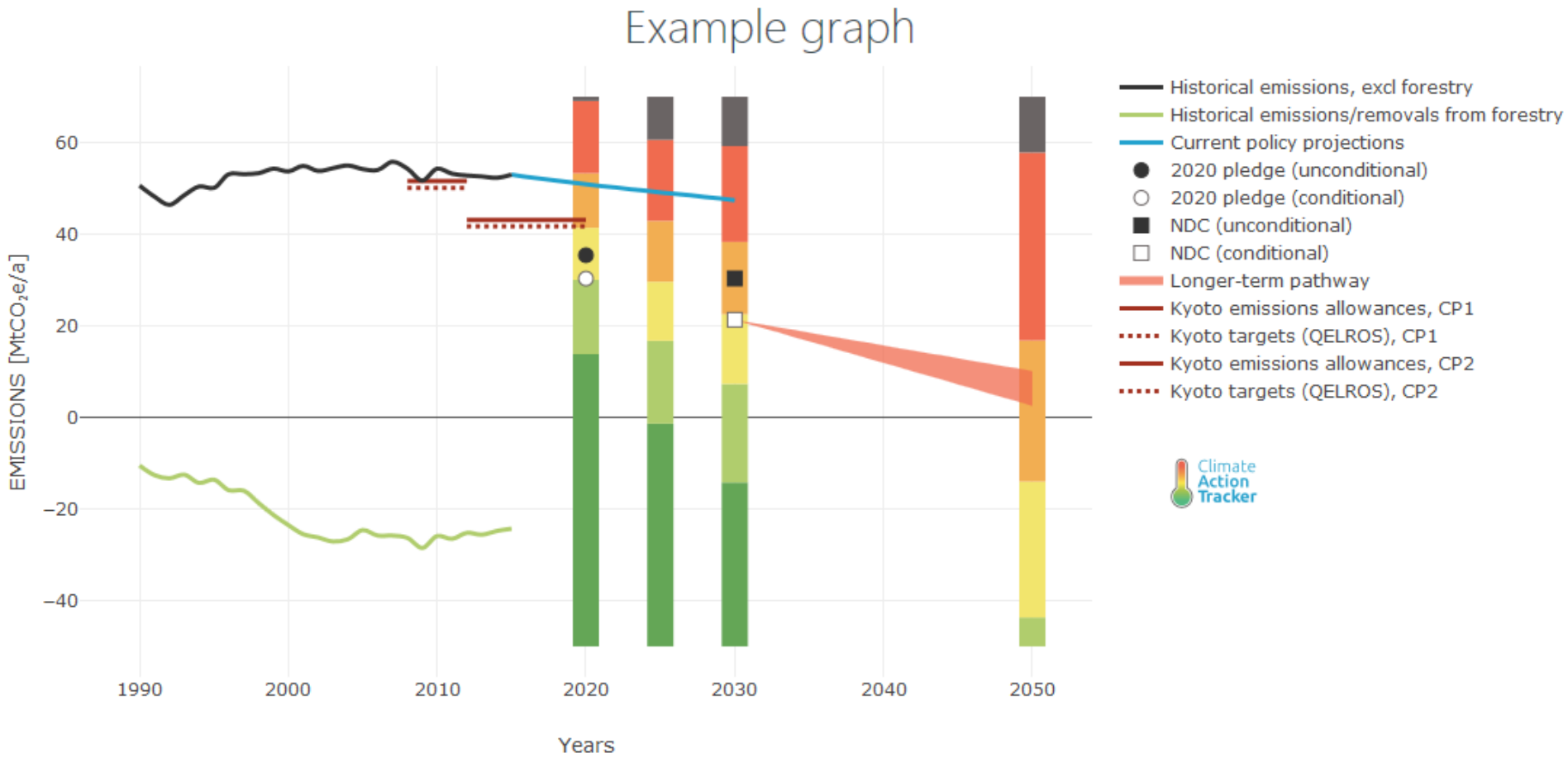
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
4°C+ WORLD	*< 4°C WORLD*	*< 3°C WORLD*	*< 2°C WORLD*	*< 1.5°C WORLD*	*<< 1.5°C WORLD*
RUSSIAN FEDERATION	ARGENTINA	AUSTRALIA	BHUTAN	MOROCCO	
SAUDI ARABIA	CHILE	BRAZIL	COSTA RICA	THE GAMBIA	
TURKEY	CHINA	CANADA	ETHIOPIA		
USA	INDONESIA	EU	INDIA		
UKRAINE	JAPAN	KAZAKHSTAN	KENYA		
VIET NAM	SINGAPORE	MEXICO	PHILIPPINES		
	SOUTH AFRICA	NEW ZEALAND			
	SOUTH KOREA	NORWAY			
	UAE	PERU			
		SWITZERLAND			

Global NDC Adequacy



CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
4°C+ WORLD	*< 4°C WORLD*	*< 3°C WORLD*	*< 2°C WORLD*	*< 1.5°C WORLD*	*<< 1.5°C WORLD*

Climate Action Tracker



China

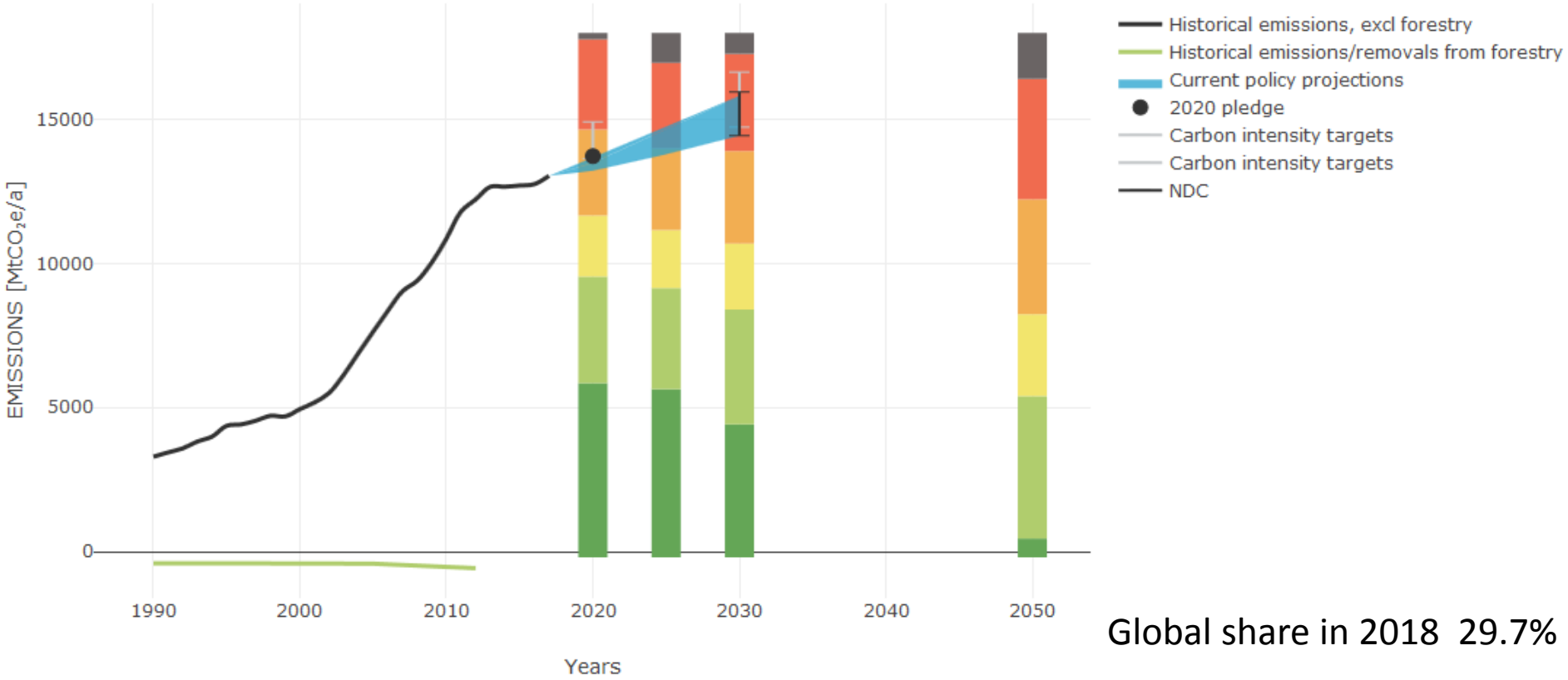
CHOOSE UPDATE TO VIEW 2 Dec 2019

SHARE

4°C+ WORLD | < 4°C WORLD | < 3°C WORLD | < 2°C WORLD | < 1.5°C WORLD | << 1.5°C WORLD

CRITICALLY INSUFFICIENT | **HIGHLY INSUFFICIENT** | INSUFFICIENT | 2°C COMPATIBLE | 1.5°C PARIS AGREEMENT COMPATIBLE | ROLE MODEL

Commitments with this rating fall outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C.



Global share in 2018 29.7%

CHINA

Summary of pledges and targets

Climate Action Tracker

PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	Peak CO_2 emissions latest by 2030 Non-fossil share: 20% in 2030 Forest stock: + 4.5 billion m^3 by 2030 compared to 2005 Carbon Intensity: -60% to -65% below 2005 by 2030 [33–47% above 2010 by 2030 excl. LULUCF for peaking and non-fossil targets] [36–53% above 2010 by 2030 excl. LULUCF for carbon intensity targets]
	Coverage	Economy-wide
	LULUCF	Unclear how LULUCF is included
COPENHAGEN ACCORD	2020 target(s)	Carbon intensity: -40% to -45% below 2005 by 2020 Non-fossil share of energy supply: 15% in 2020 Forest cover: +40 million ha by 2020 compared to 2005 Forest stock: + 1.3 billion m^3 by 2020 compared to [26% above 2010 by 2030 excl. LULUCF for non-fossil target] [26–37% above 2010 by 2030 excl. LULUCF for carbon intensity targets]
	Condition(s)	None
LONG-TERM GOAL(S)	Long-term goal(s)	None

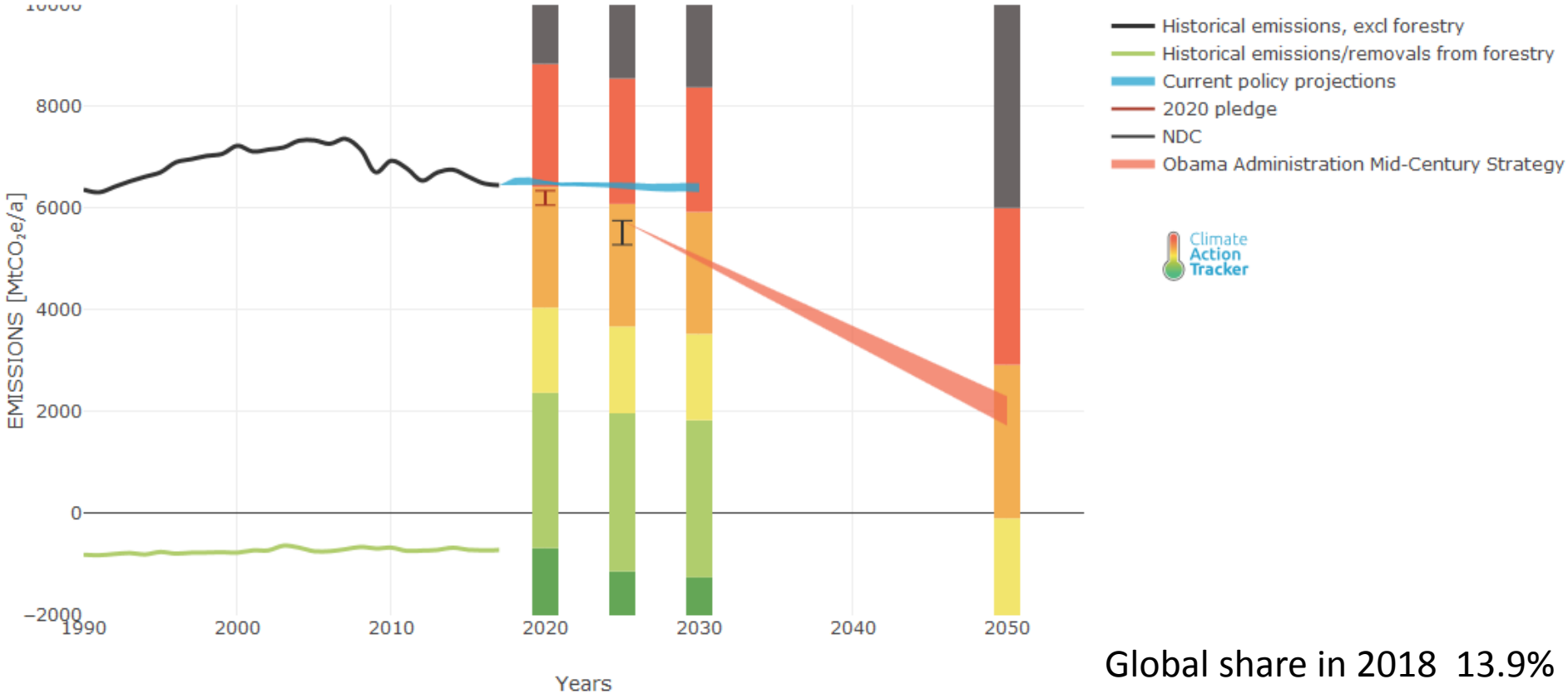
USA

CHOOSE UPDATE TO VIEW 2 Dec 2019

SHARE

4°C+ WORLD	< 4°C WORLD	< 3°C WORLD	< 2°C WORLD	< 1.5°C WORLD	<< 1.5°C WORLD
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL

Commitments with this rating fall well outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would exceed 4°C.



Global share in 2018 13.9%

USA

Summary of pledges and targets

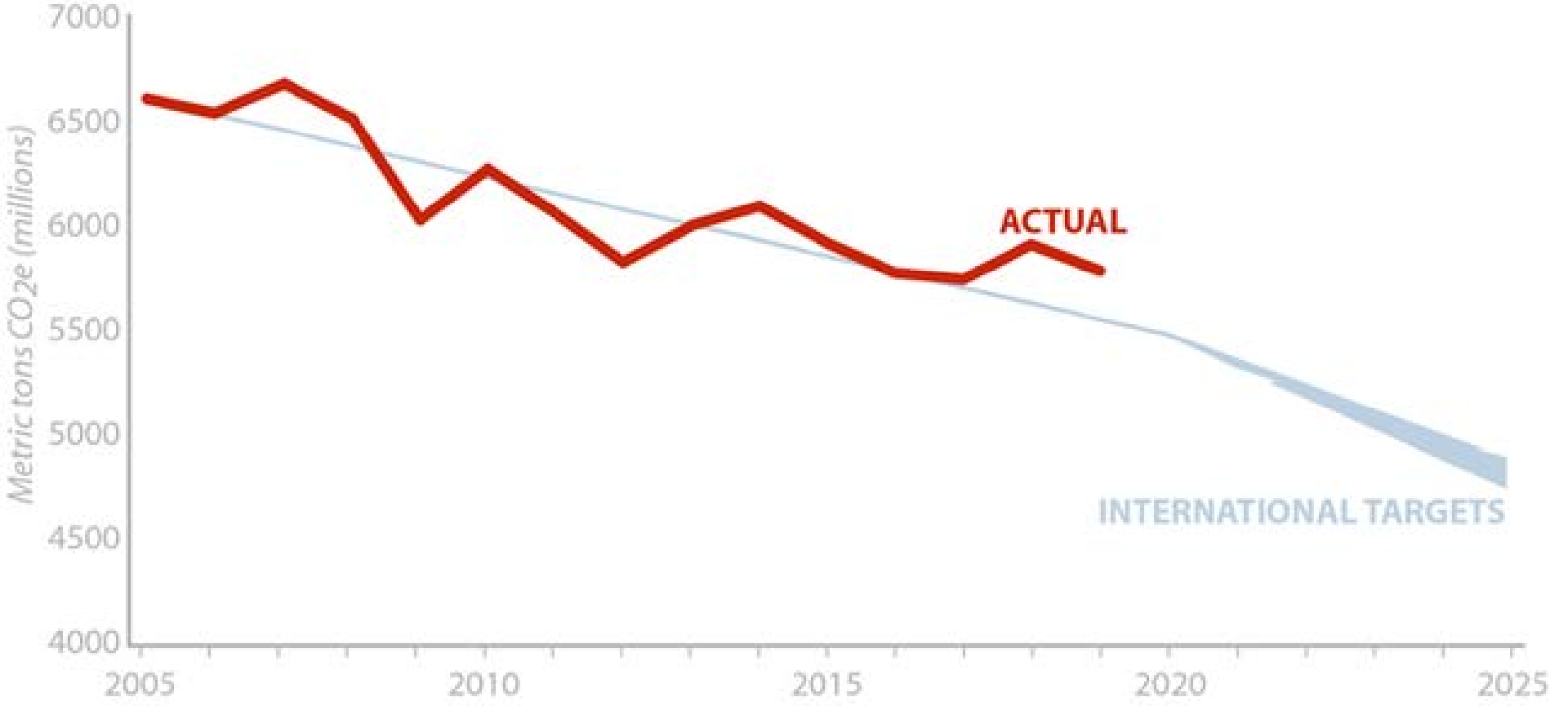
PARIS AGREEMENT	Ratified	Yes, but communicated intent to withdraw
	2030 unconditional target(s)	26–28% below 2005 by 2025 incl. LULUCF [10–17% below 1990 by 2025 excl. LULUCF]
	Coverage	Economy-wide, incl. LULUCF
	LULUCF	Included
COPENHAGEN ACCORD	2020 target(s)	17% below 2005 by 2020 incl. LULUCF [0–5% below 1990 by 2020 excl. LULUCF]
	Condition(s)	None
KYOTO PROTOCOL (KP)	Member of KP CP1 (2008–2012)	Not ratified
	Member of KP CP2 (2013–2020)	No
	KP CP1 target (below base year)	7% below 1990
	KP CP2 target (below base year)	N/A
LONG-TERM GOAL(S)	Long-term goal(s)	Obama Administration Mid-Century Strategy: 80% below 2005 levels by 2050 incl. LULUCF [68–76% below 2005 by 2050 excl. LULUCF] 76% below 1990 incl. LULUCF

*based on CAT calculations

U.S. Emissions 2005 - 2019

U.S. NET GREENHOUSE GAS EMISSIONS RELATIVE TO INTERNATIONAL COMMITMENTS

In millions of metric tons CO_2e, excludes international bunker fuel use, 2005-2019

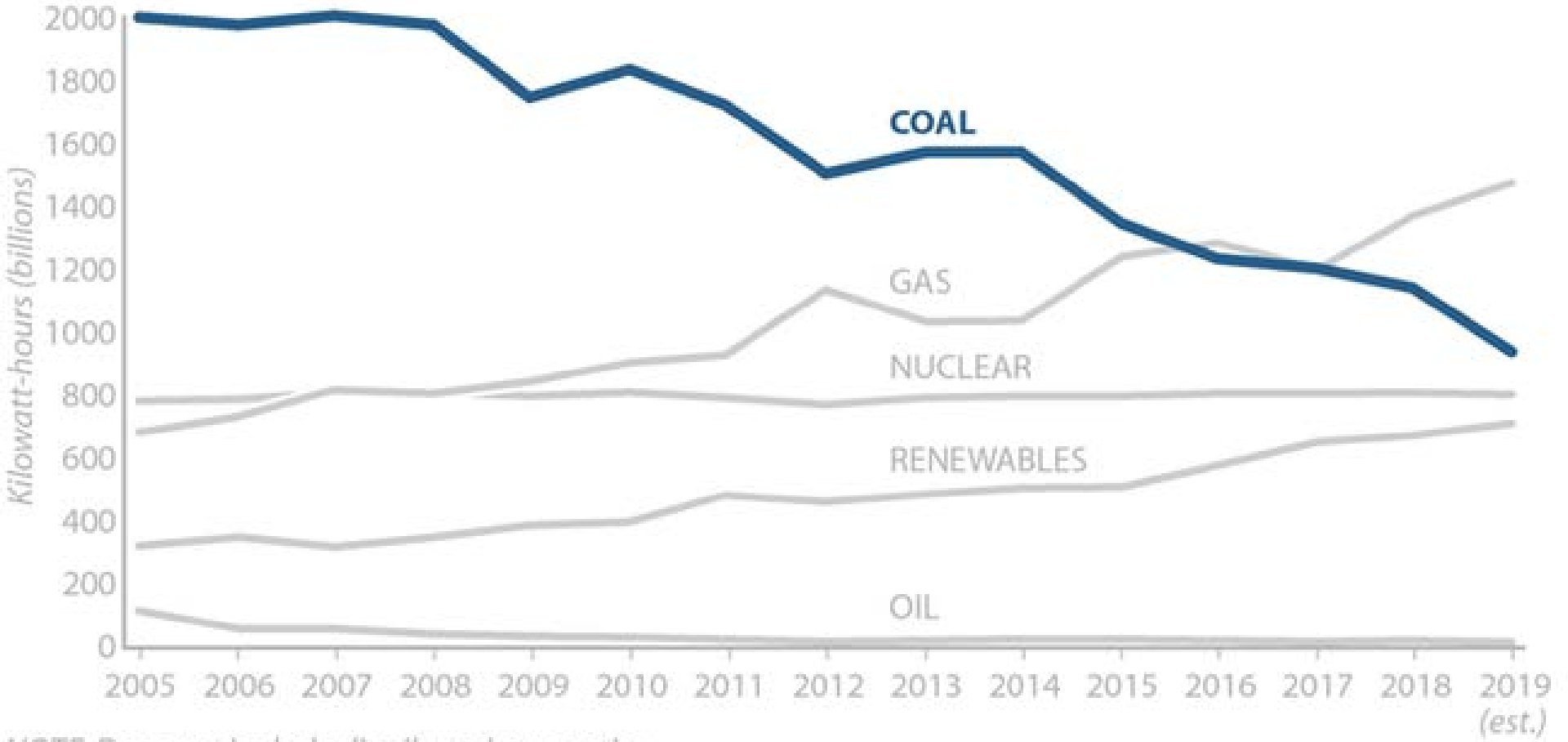


SOURCE: Rhodium Climate Service

InsideClimate News

U.S. POWER GENERATION BY ENERGY SOURCE

Electric power sector only, in billions of kilowatt-hours, 2005-2019



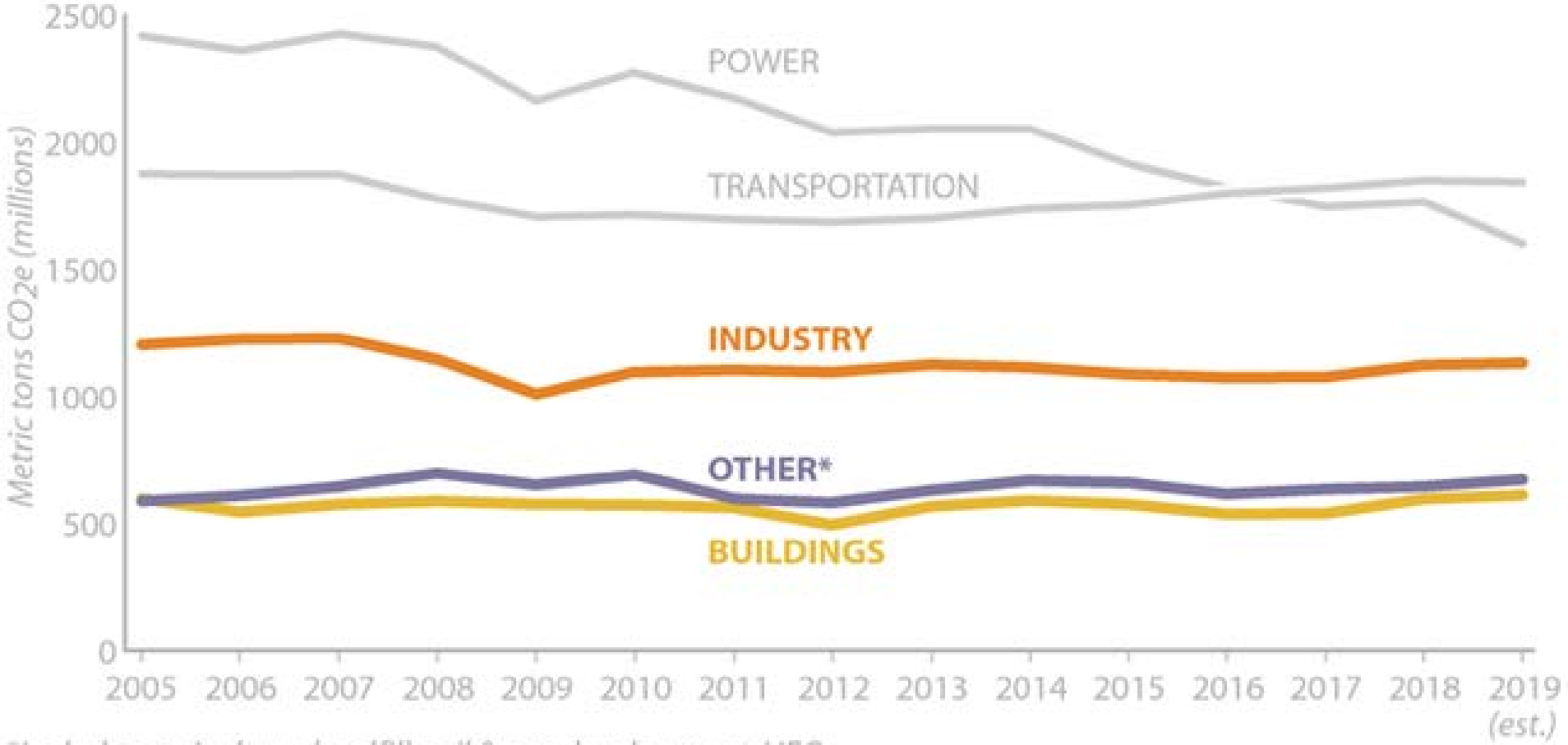
NOTE: Does not include distributed generation

SOURCE: Rhodium Climate Service

InsideClimate News

U.S. NET GREENHOUSE GAS EMISSIONS BY SECTOR

In millions of metric tons CO_2e, excludes international bunker fuel use, 2005-2019



*Includes agriculture, landfills, oil & gas development, HFCs

SOURCE: Rhodium Climate Service

InsideClimate News

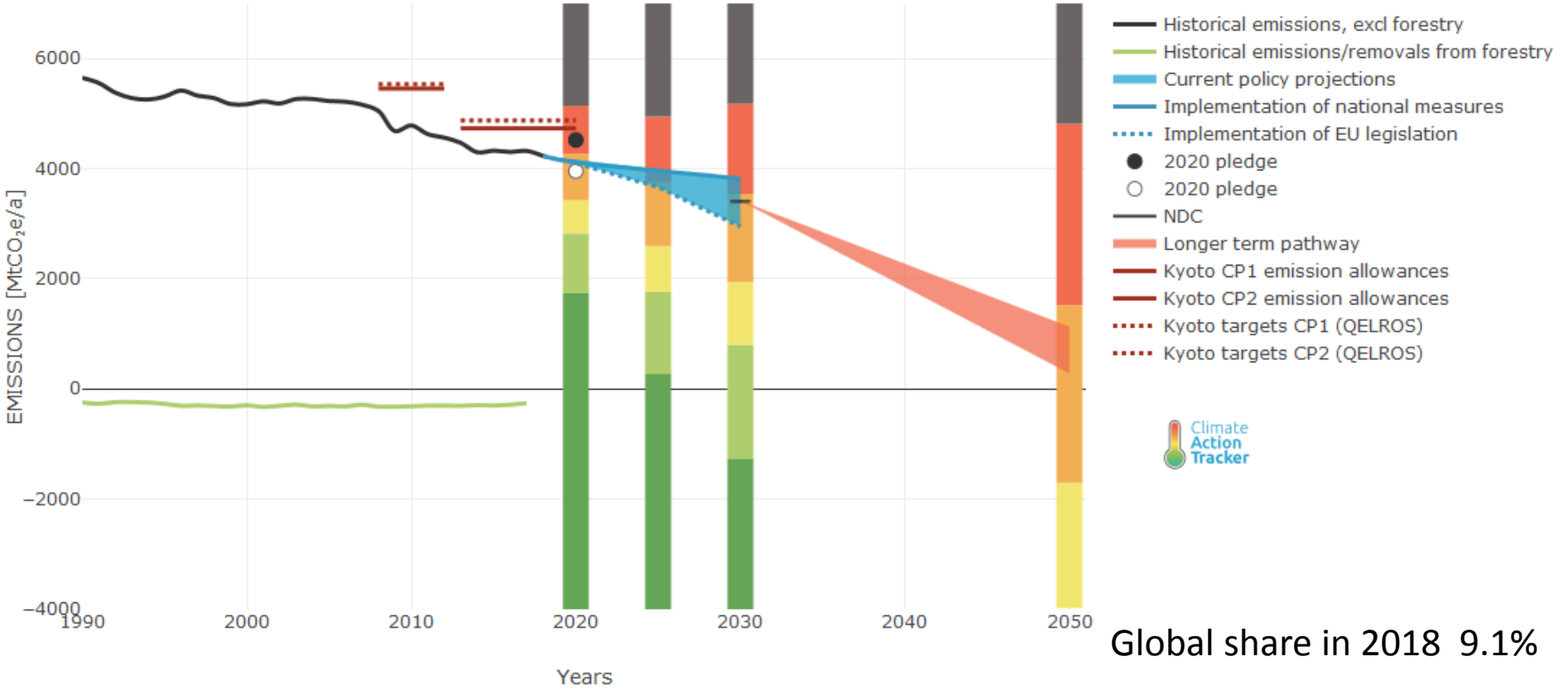
EU

CHOOSE UPDATE TO VIEW 2 Dec 2019

SHARE

4°C+ WORLD	< 4°C WORLD	< 3°C WORLD	< 2°C WORLD	< 1.5°C WORLD	<< 1.5°C WORLD
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	**INSUFFICIENT**	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL

Commitments with this rating are in the least stringent part of their fair share range and not consistent with holding warming below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach over 2°C and up to 3°C.



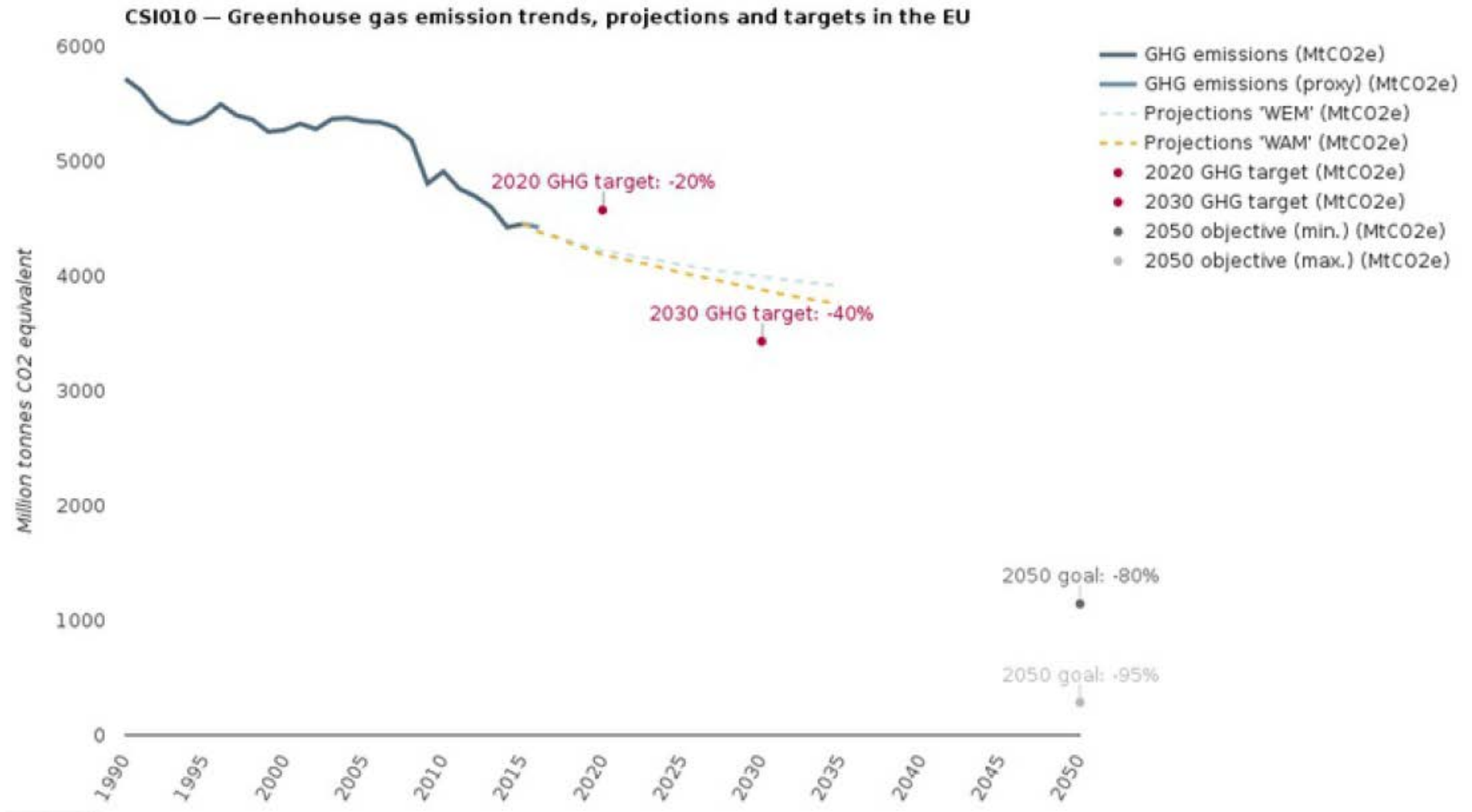
Global share in 2018 9.1%

EU

Summary of pledges and targets

PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	At least 40% below 1990 by 2030 [29% below 2010 by 2030]
	Coverage	Economy-wide GHG coverage
COPENHAGEN ACCORD	2020 target(s)	20–30% below 1990 by 2020
	Condition(s)	Developed countries commit to comparable efforts and developing countries contribute according to capabilities.
KYOTO PROTOCOL (KP)	Member of KP CP1 (2008–2012)	Yes
	Member of KP CP2 (2013–2020)	Yes
	KP CP1 target (below base year)	8% below 1990
	KP CP2 target (below base year)	20% below 1990
LONG-TERM GOAL(S)	Long-term goal(s)	80–95% below 1990 by 2050 (under discussion) [76-94% below 2010 by 2050]

EU GHG Emissions History and Projections



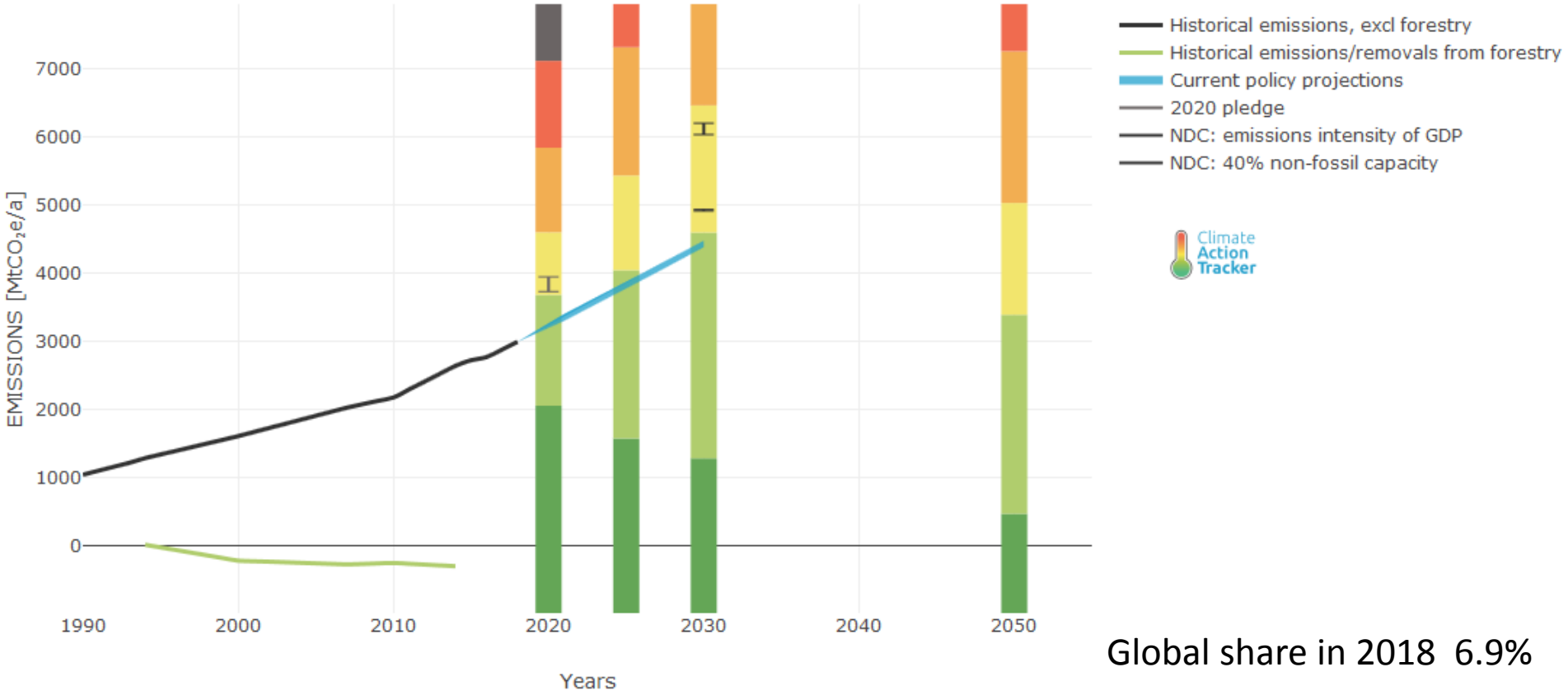
India

CHOOSE UPDATE TO VIEW 2 Dec 2019

SHARE

4°C+ WORLD	< 4°C WORLD	< 3°C WORLD	**< 2°C WORLD**	< 1.5°C WORLD	<< 1.5°C WORLD
CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	**2°C COMPATIBLE**	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL

Commitments with this rating are consistent with the 2009 Copenhagen 2°C goal and therefore fall within the country's fair share range, but are not fully consistent with the Paris Agreement. If all government targets were in this range, warming could be held below, but not well below, 2°C and still be too high to be consistent with the Paris Agreement 1.5°C limit.



Global share in 2018 6.9%

INDIA

Summary of pledges and targets

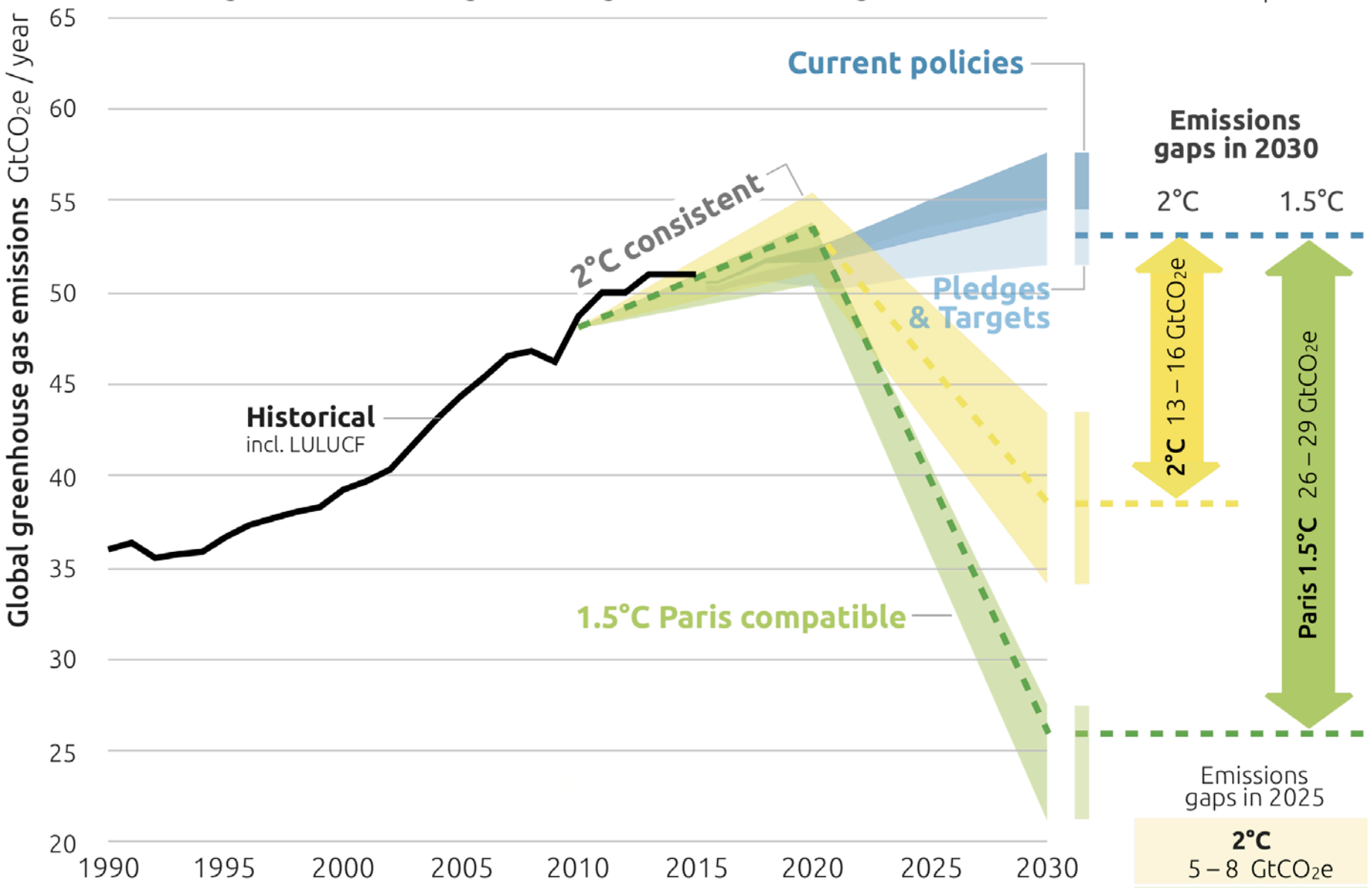
PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	33% to 35% below 2005 emissions intensity of GDP by 2030 [479–495% above 1990 by 2030 excl. LULUCF] [177–185% above 2010 by 2030 excl. LULUCF]
	2030 conditional target(s)	Non-fossil share of cumulative power generation capacity 40% by 2030 [371–373% above 1990 by 2030 excl. LULUCF] [126–127% above 2010 by 2030 excl. LULUCF]
	Condition(s)	Transfer of technology and low cost international finance incl. from GCF
	Coverage	Not specified
	LULUCF	Additional (cumulative) carbon sink of 2.5–3 GtCO2e by 2030
COPENHAGEN ACCORD	2020 target(s)	20–25% below 2005 emissions intensity of GDP by 2020 [258–279% above 1990 by 2020 excl. LULUCF] [71–81% above 2010 by 2030 excl. LULUCF]
	Coverage	Excluding agriculture sector
	Condition(s)	None
LONG-TERM GOAL(S)	Long-term goal(s)	Per capita emissions never to exceed those of the developed world

2030 EMISSIONS GAPS

CAT projections and resulting emissions gaps in meeting the 1.5°C Paris Agreement goal vs 2°C Cancún goal

Climate Action Tracker

Dec 2019 update



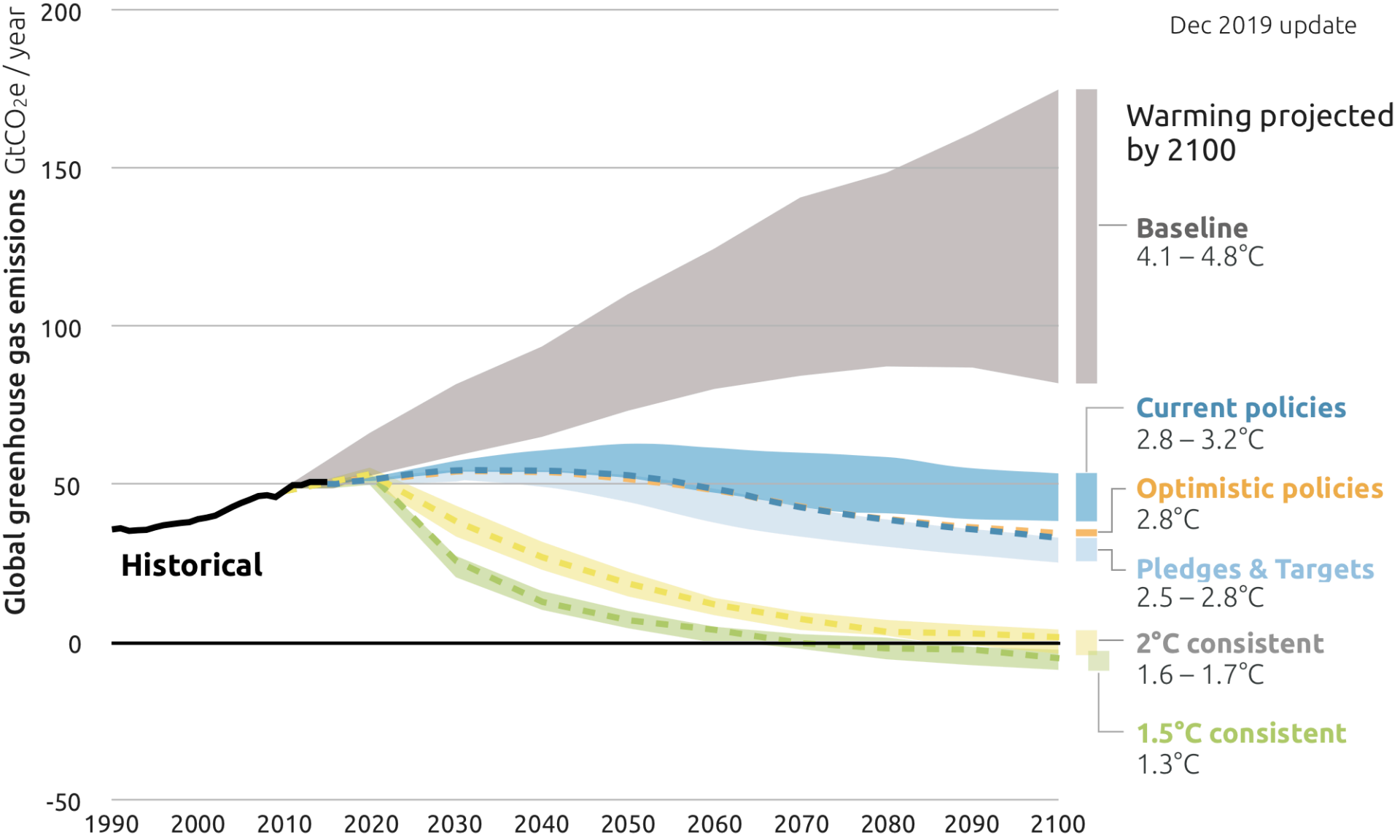
The "gap" range results only from uncertainties in the pledge projections.
Gaps are calculated against the mean of the benchmark emissions for 1.5°C and 2°C.

2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies

Climate Action Tracker

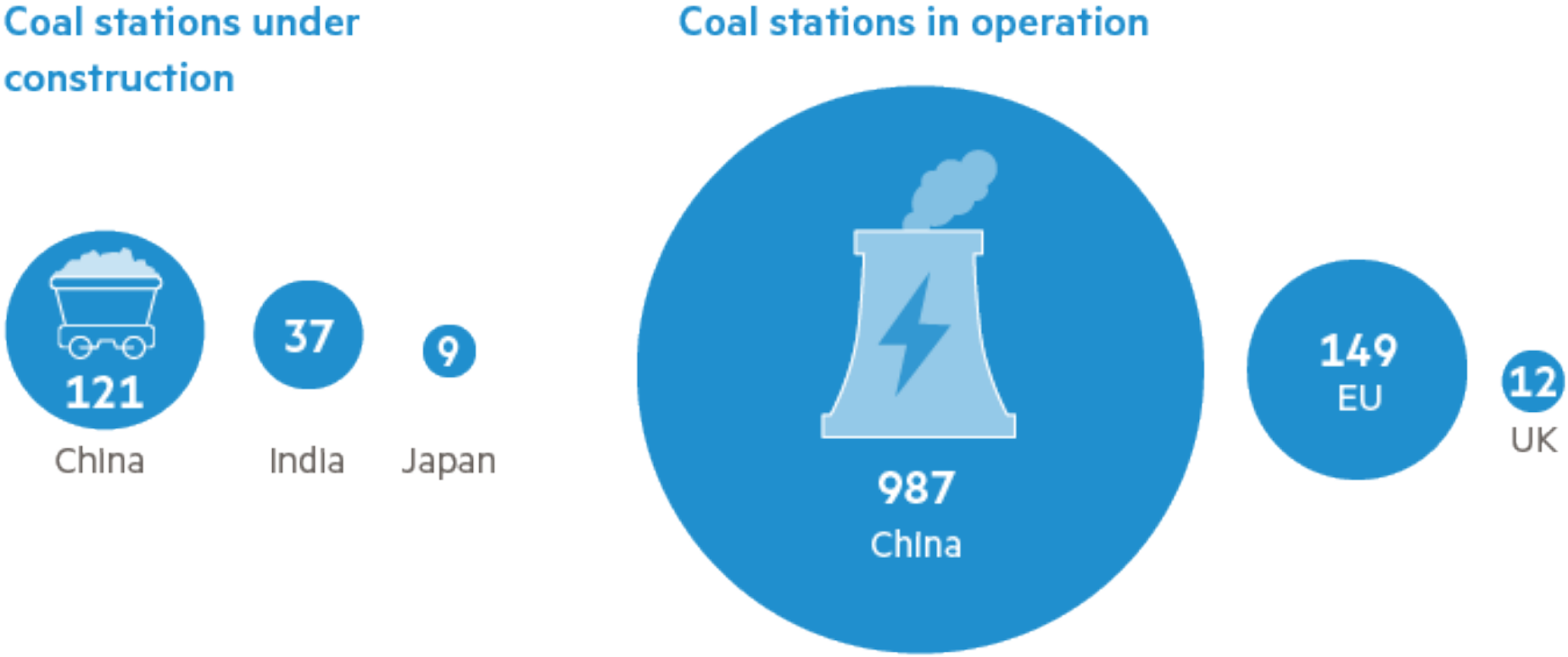
Dec 2019 update



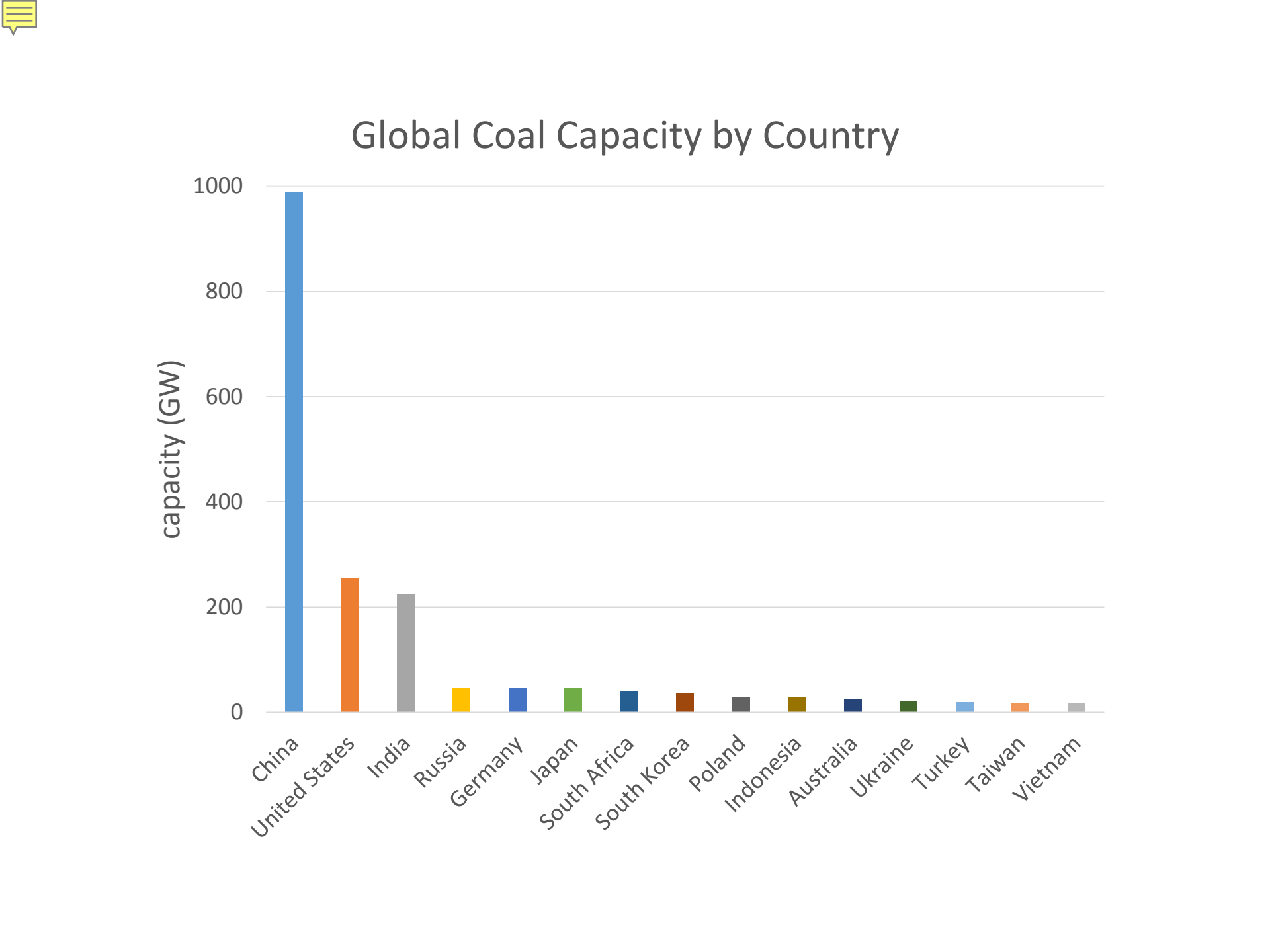
What Happens to Coal?

Coal Plant Status, 2019

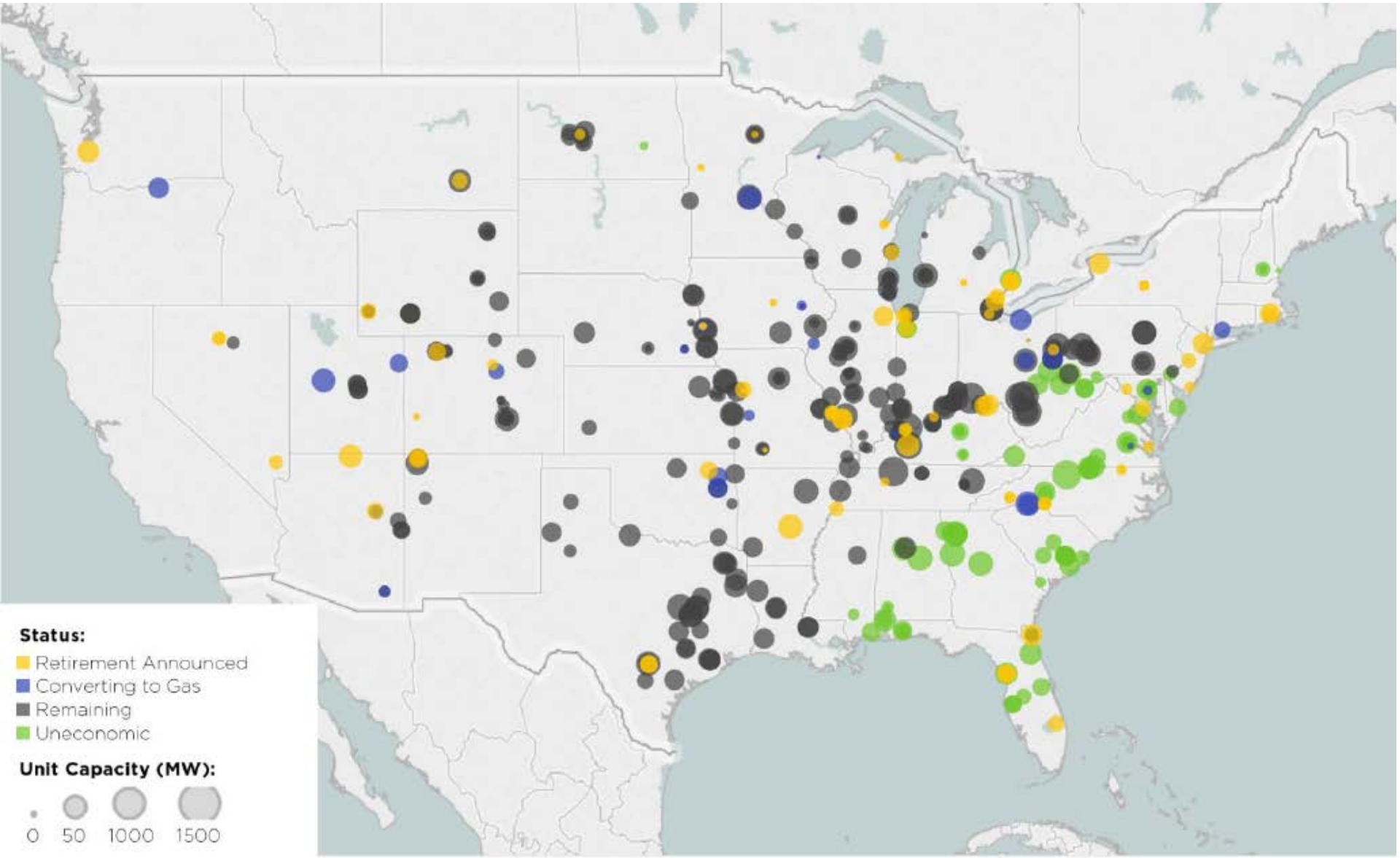
China has more coal fired power plants under construction than the rest of the world combined (power in gigawatts)



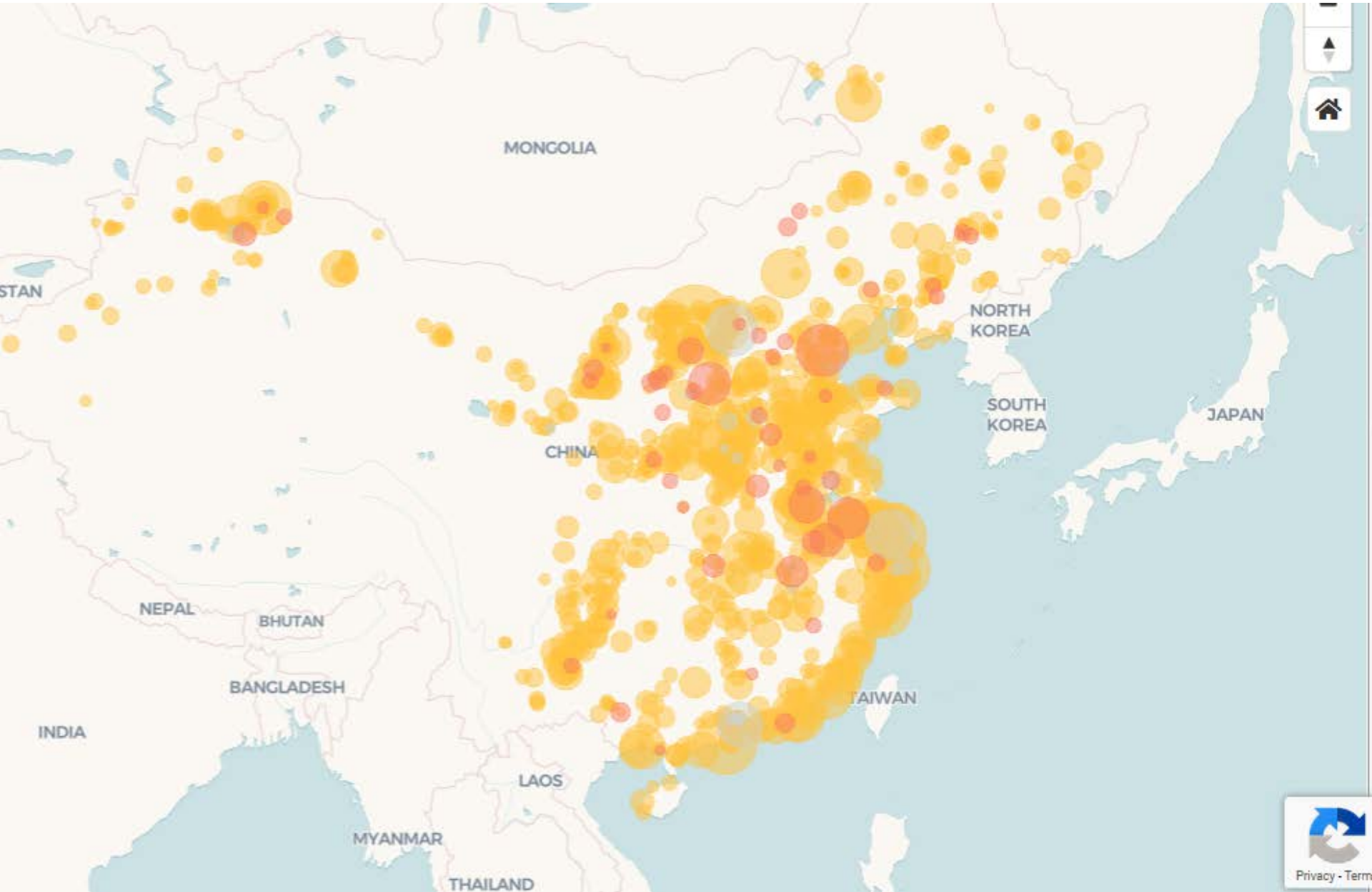
Source: Global Energy Monitor


Global Coal Capacity by Country
capacity (GW)
1000
800
600
400
200
0
China
United States
India
Russia
Germany
Japan
South Africa
South Korea
Poland
Indonesia
Australia
Ukraine
Turkey
Taiwan
Vietnam

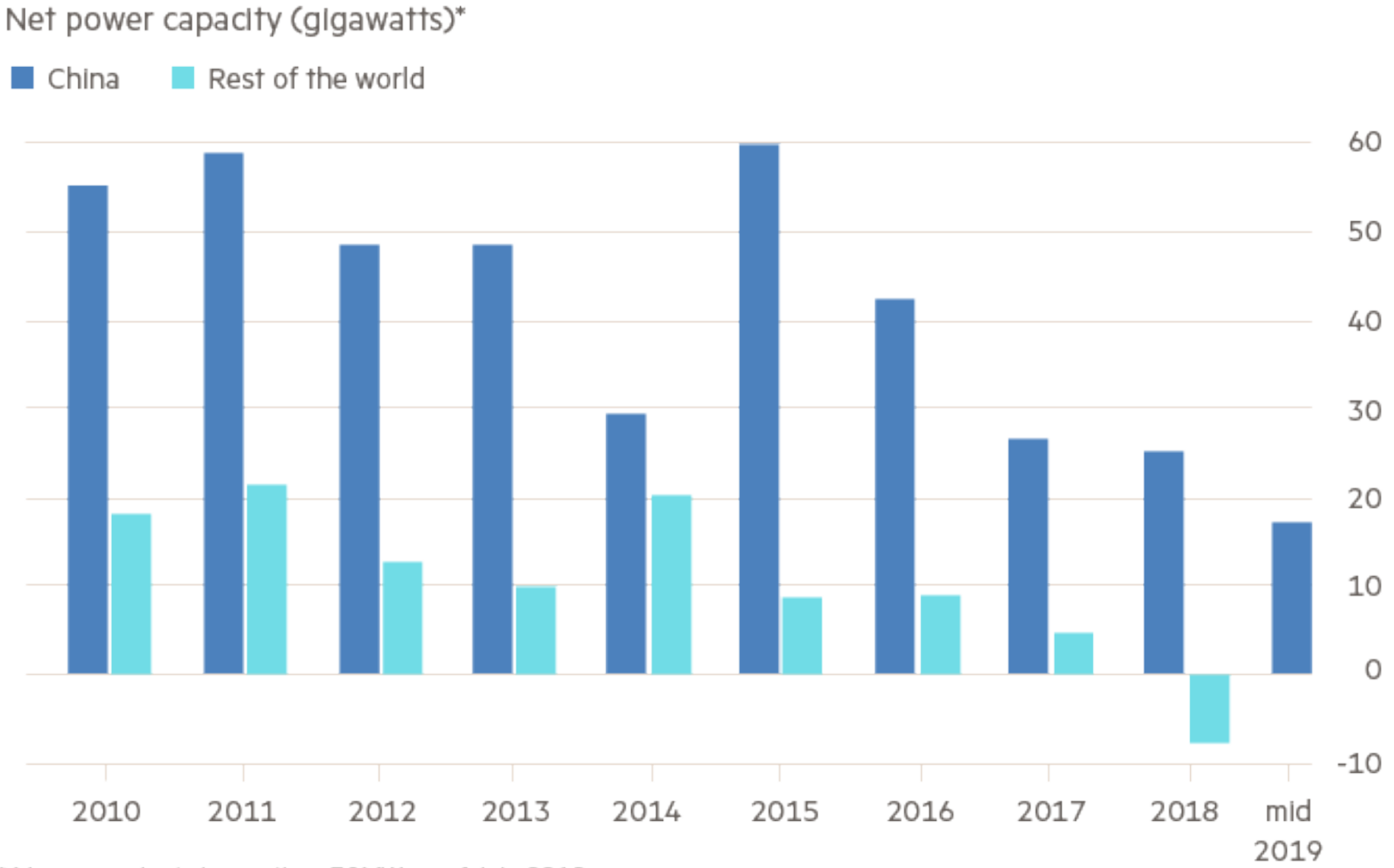
UCS Coal Plant Status, 2016



China Coal Plant Map



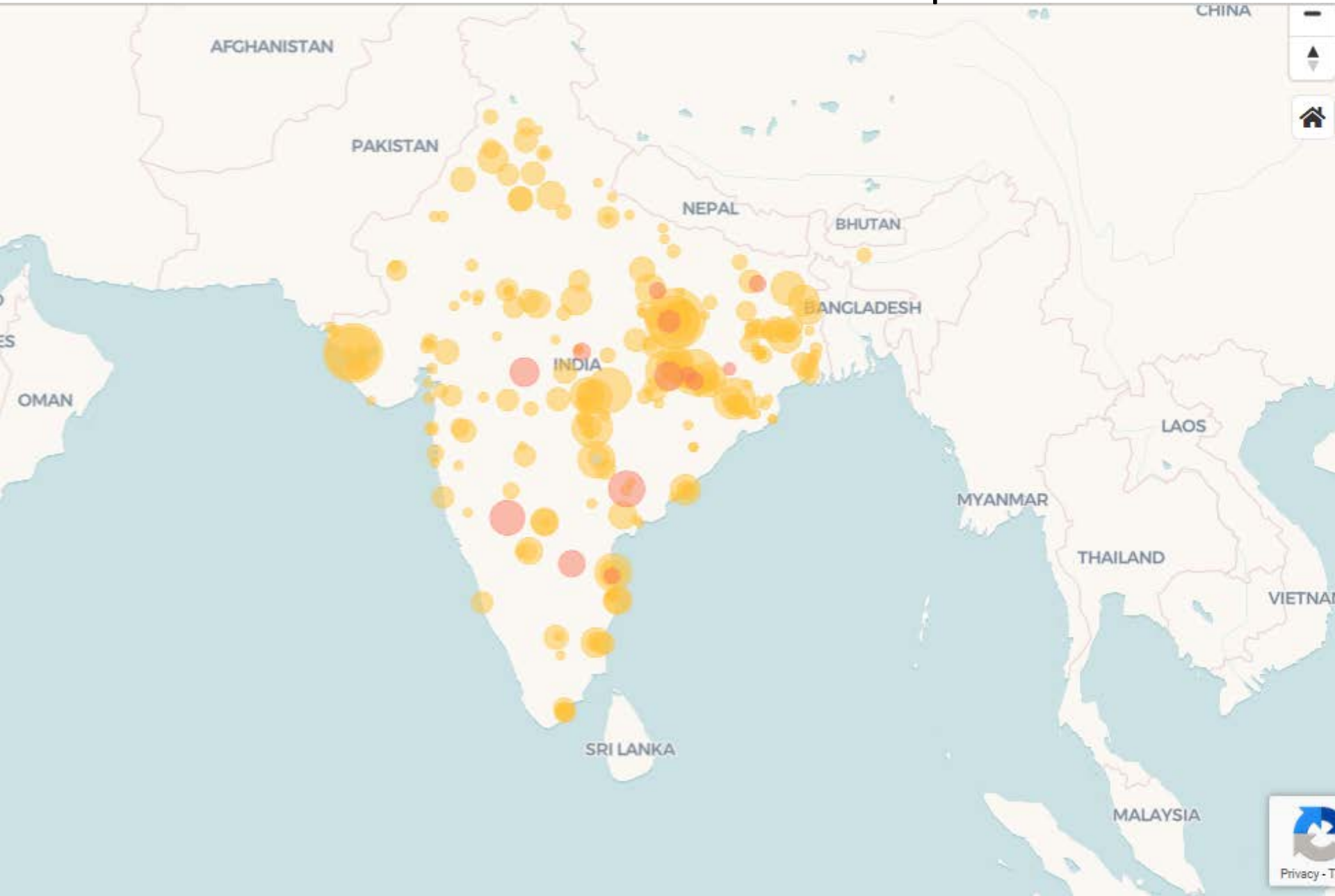
China Coal Plant Construction 2010-2019



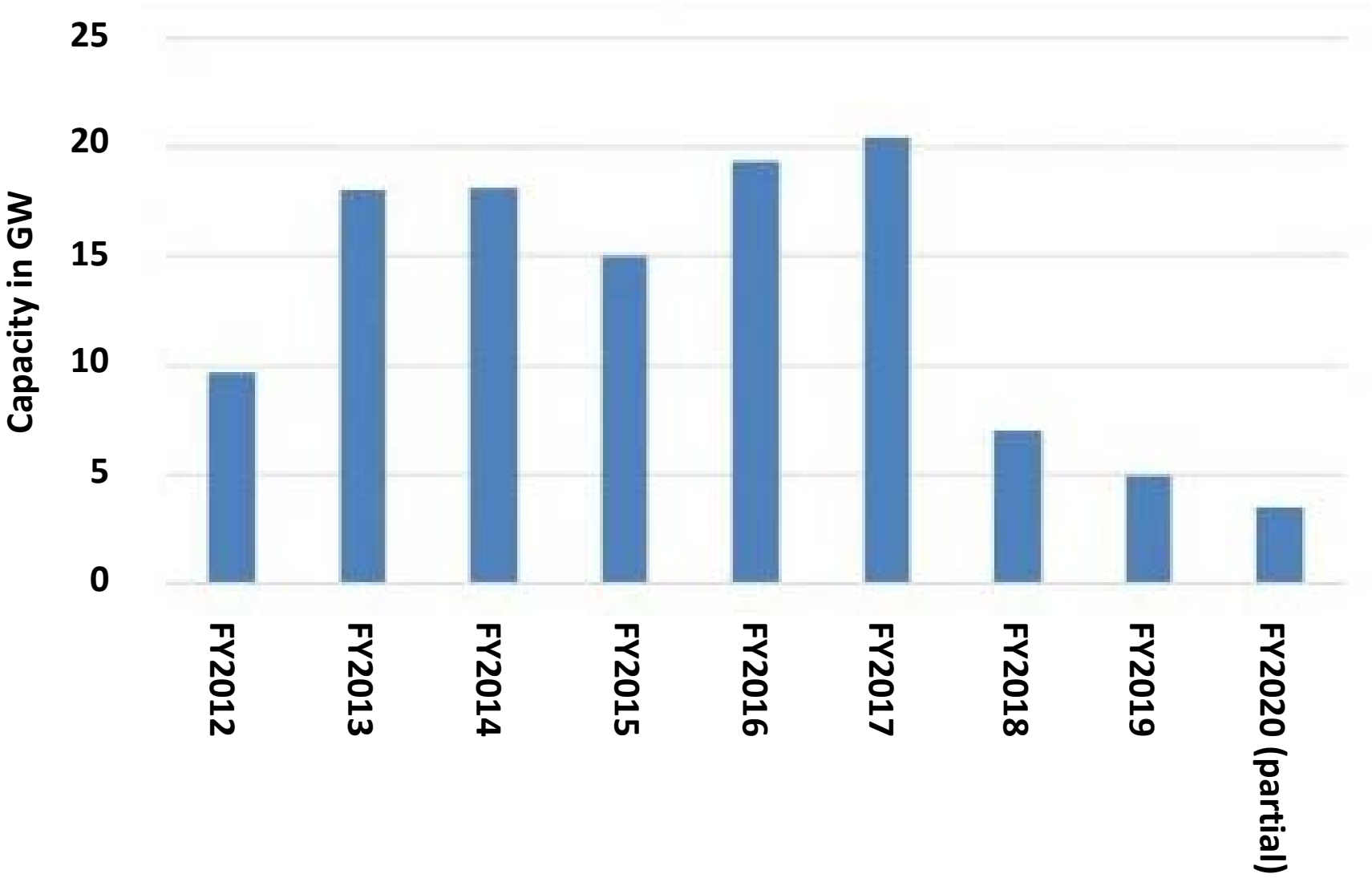
* Measures plants larger than 30MW, as of July 2019

Source: GEM, Global Coal Plant Tracker (July 2019)

India Coal Plant Map



India Coal Plant Construction 2012-2019



Green Climate Fund

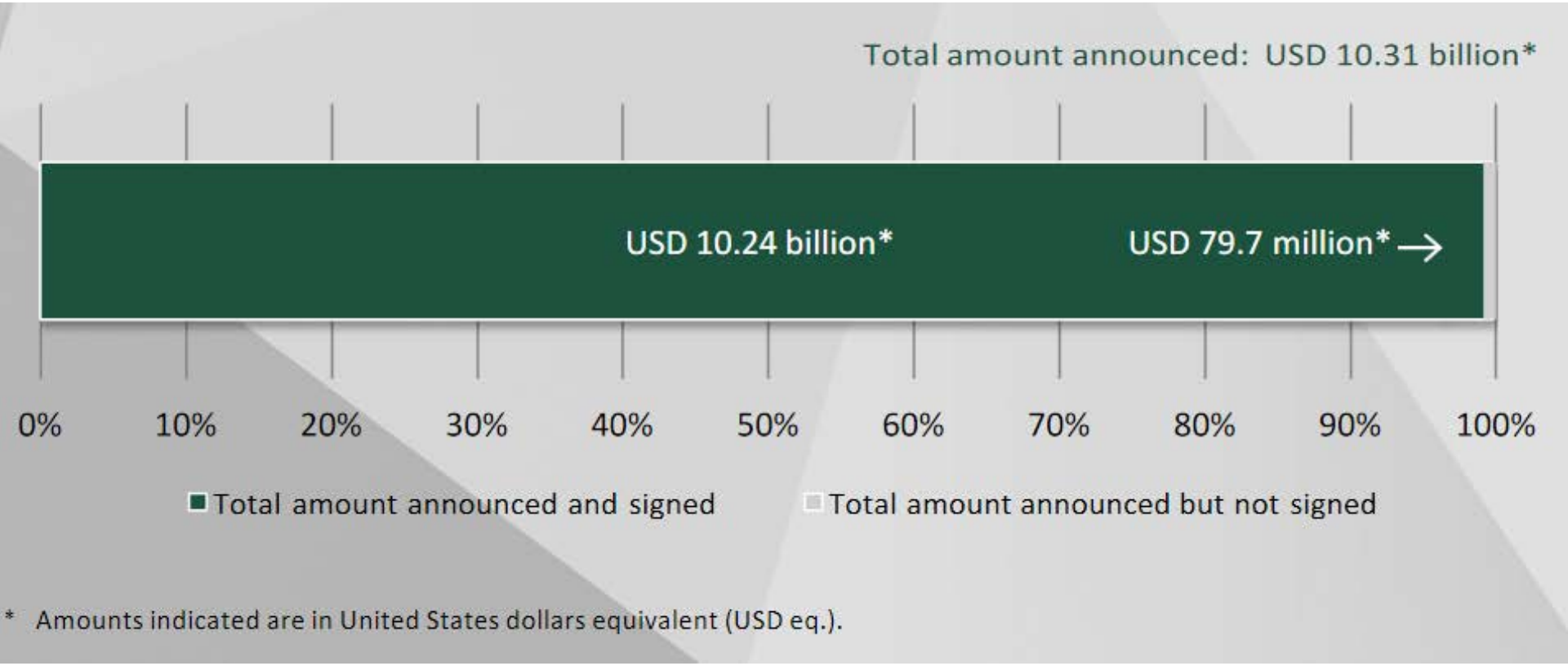
Paris Agreement: Green Climate Fund of $100 billion by 2020 and then $100 billion annually to 2025

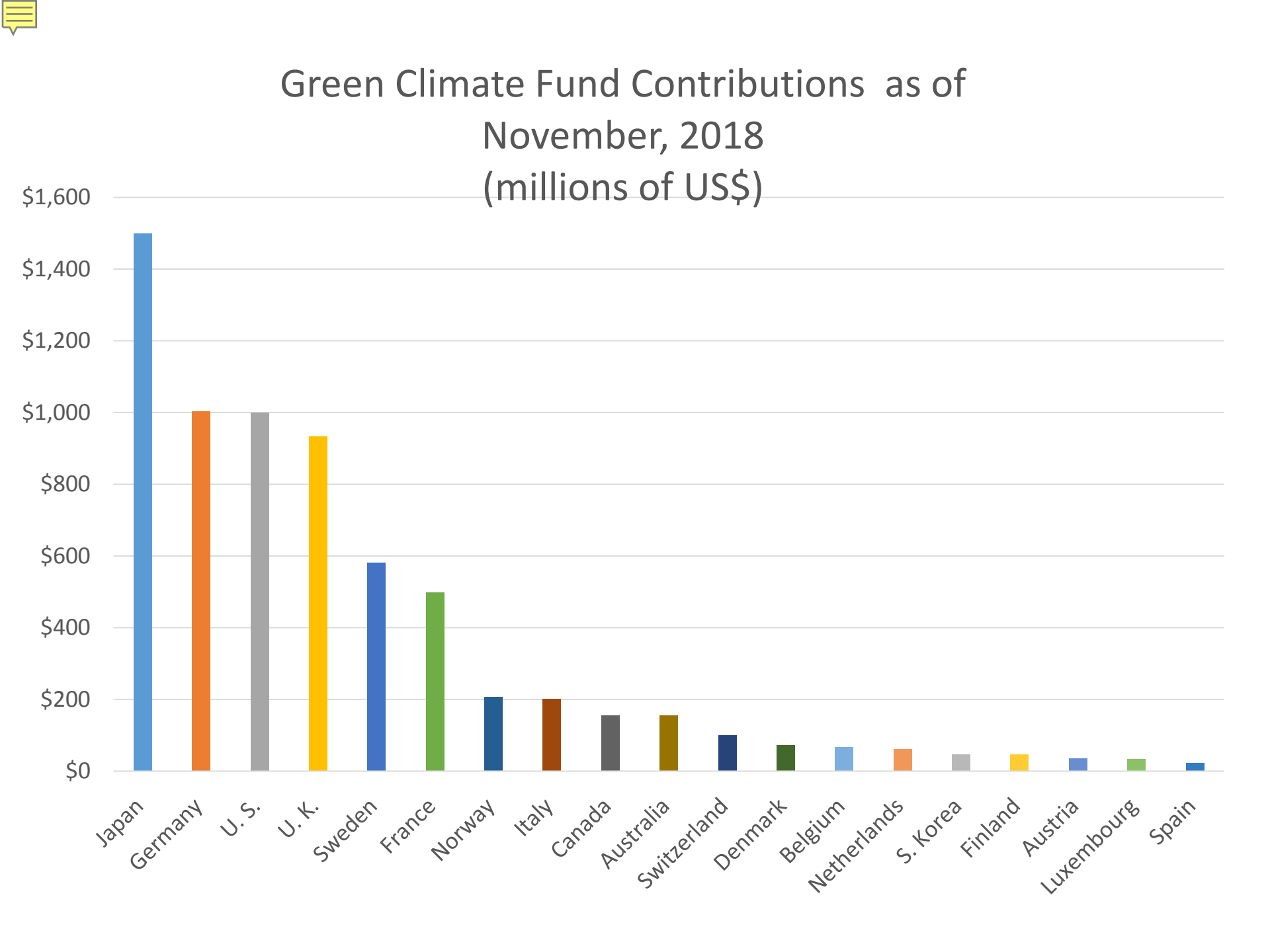
The New York Times

September 8, 2018

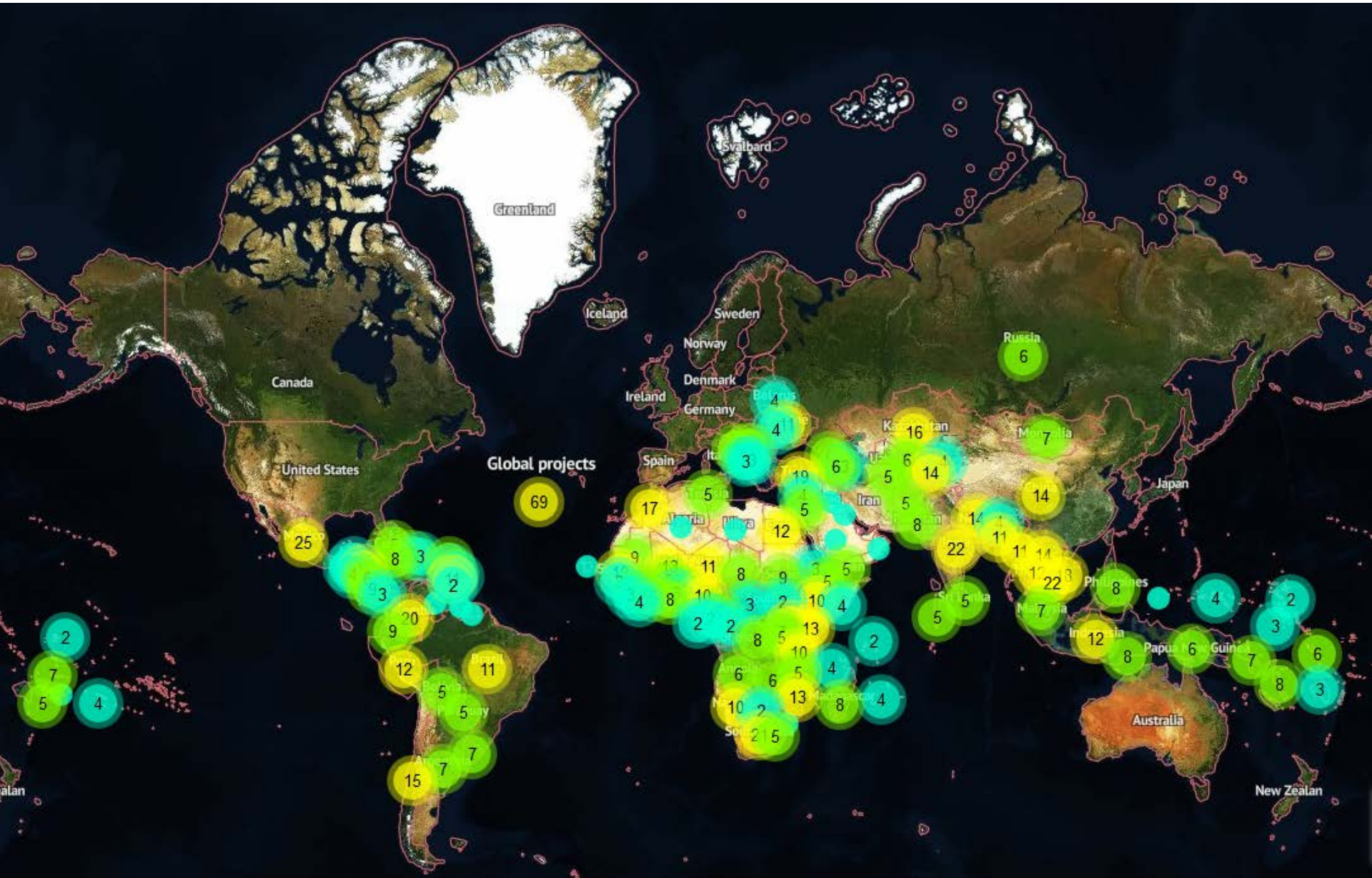
Rich Nations Vowed Billions for Climate Change. Poor Countries Are Waiting.

Green Climate Fund Pledges as of April 2019




Green Climate Fund Contributions as of November, 2018 (millions of US$)
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Japan
Germany
U. S.
U. K.
Sweden
France
Norway
Italy
Canada
Australia
Switzerland
Denmark
Belgium
Netherlands
S. Korea
Finland
Austria
Luxembourg
Spain

Locations of Green Climate Fund Projects



COP-21
Paris, France
November 30, 2015 – December 12, 2015

More COPs


Nations Unies
Conférence sur les Changements Climatiques 2015
Paris, France
Nations Unies
Conférence sur les Changements Climatiques 2015
COP21/CMP11
Paris, France

COP-22
Marrakesh, Morocco
November 7 – 18, 2016


MARRAKECH 2016
COP22 | CMP12 | CMA1

COP-22 Outcome

- Paris Agreement affirmed by Marrakesh Action Proclamation
- 100 G$ Green Climate Fund goal by 2020 affirmed
- NDC evaluation rulebook debate continued
- Loss and damage discussion continued
- Deadline for updated NDCs May, 2017
- 2050 Pathway Platform signed on by 22 countries, 15 cities, and 196 businesses
- 47 poor nations sign on to 100% renewables as soon as possible

COP-23 Bonn
November 6 – 17, 2017

COP-23 Bonn November 6 – 17, 2017

The New York Times

November 18, 2017

What Happened (and Didn't) at the Bonn Climate Talks

- "…another year of saving the process, if not the planet…"
- No new Paris agreement individual pledges
- No new Green Climate fund contributions
- Rulebook to verify Paris pledges by COP24 in 2018
- Loss and damage debated

COP-24
Kotowice, Poland
December 3 – 14, 2018

Display Promoting Coal at COP-24

COP-24 Delegates Celebrate

COP-24 Outcomes

- Nationally Determined Contributions (NDC) remain vehicle for emissions reductions
- NDCs remain voluntary
- NDCs must use standardized methodology and must be submitted biannually
- NDCs reporting requirements recognize three classes of nations: industrialized, developing, LDC/SIDS
- Market mechanisms for meeting NDCs are under negotiation
- Loss and damage payments and climate adaptation financing have not been addressed

COP-25
Madrid, Spain
December 2 – 13, 2019


#TiempoDeActuar
COP25
CHILE
MADRID 2019
#TimeForAction

THE WALL STREET JOURNAL.

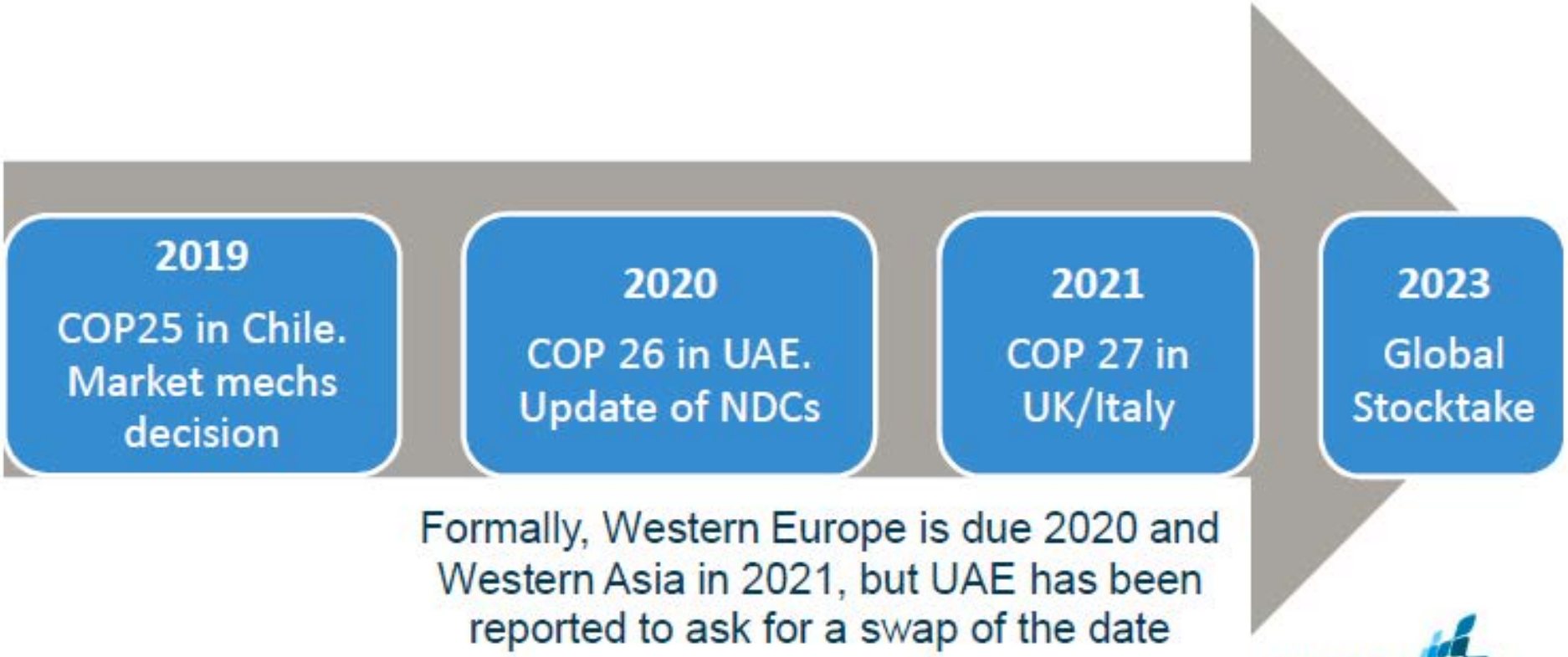
December 15, 2020

U.N. Climate Talks End Without Meeting Goals

COP-25 Summary

- Exit of United States from Paris Agreement on November 4, 2020.
- Fail to strengthen emission reduction targets
- Fail to create a carbon trading system
- Financing for poor and developing countries remains in adequate
- Loss and damage remains contentious
- EU commits to net-zero emissions by 2050
- Some corporate and investment efforts outside of Paris Agreement

COP Process Will Continue



Formally, Western Europe is due 2020 and Western Asia in 2021, but UAE has been reported to ask for a swap of the date

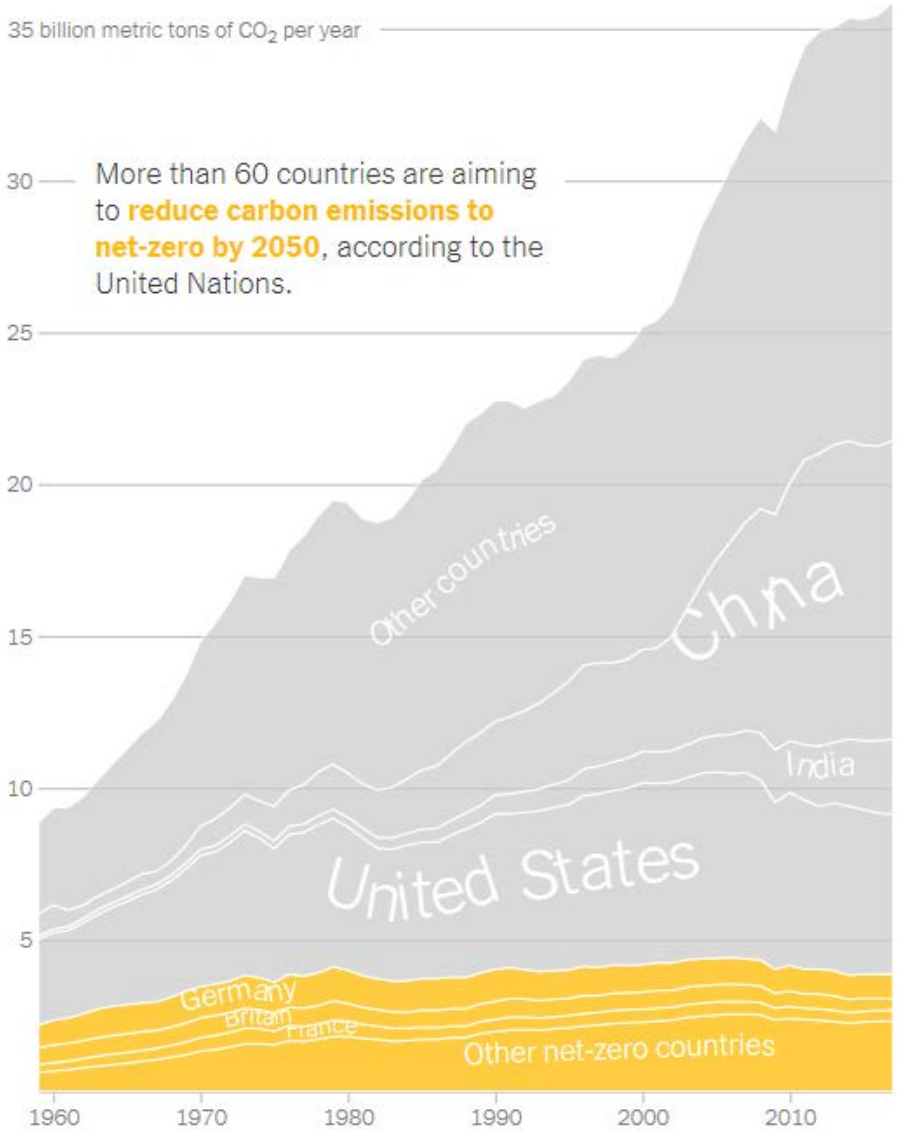
perspectives climate group

A Few Initiatives

- United States – “We Are Still In” declaration from over 3,500 governmental and civic leaders. “Green New Deal.” 100% renewable energy.
- China – Five-year plan targets for limiting coal use and deploying solar power, wind power, nuclear power, natural gas, and energy efficiency in the industrial and power sectors
- Germany – government announces exit from coal by 2038
- United Kingdom – phase out of coal, carbon tax
- Globally 51 carbon tax and exchange trading systems
- International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO) emission reduction goals
- Not all initiatives are positive: Australia, Brazil, France, etc.

The New York Times

September 25, 2019
More Than 60
Countries Say
They'll
Zero Out Carbon
Emissions.



The New York Times

January 16, 2020

How Hard Is It to Quit Coal? For Germany, 18 Years and $44 Billion

The New York Times

September 21, 2019

Protesting Climate Change, Young People Take to Streets in a Global Strike

Swedish Parliament Building
August, 2018

Hamburg, Germany

Oslo, Norway

Lahore, Pakistan

Stockholm, Sweden

Brussels, Belgium

Foley Square, Manhattan

St. Petersburg, Florida

Zagreb, Croatia

New Delhi, India

Sydney, Australia

Brisbane, Australia

Tirana, Albania

Rio de Janeiro, Brazil

Washington D.C.

Berlin, Germany

Wakiso, Uganda

Karachi, Pakistan

San Francisco, California

Bucharest, Romania

Johannesburg, South Africa

Guilin, China

CLIMATE STRIKE: WHEN THE WHOLE WORLD COMES TOGETHER TO SAVE THE WHOLE WORLD

DOUBLE ISSUE

DEC. 23 / DEC. 30, 2019

PERSON of the YEAR

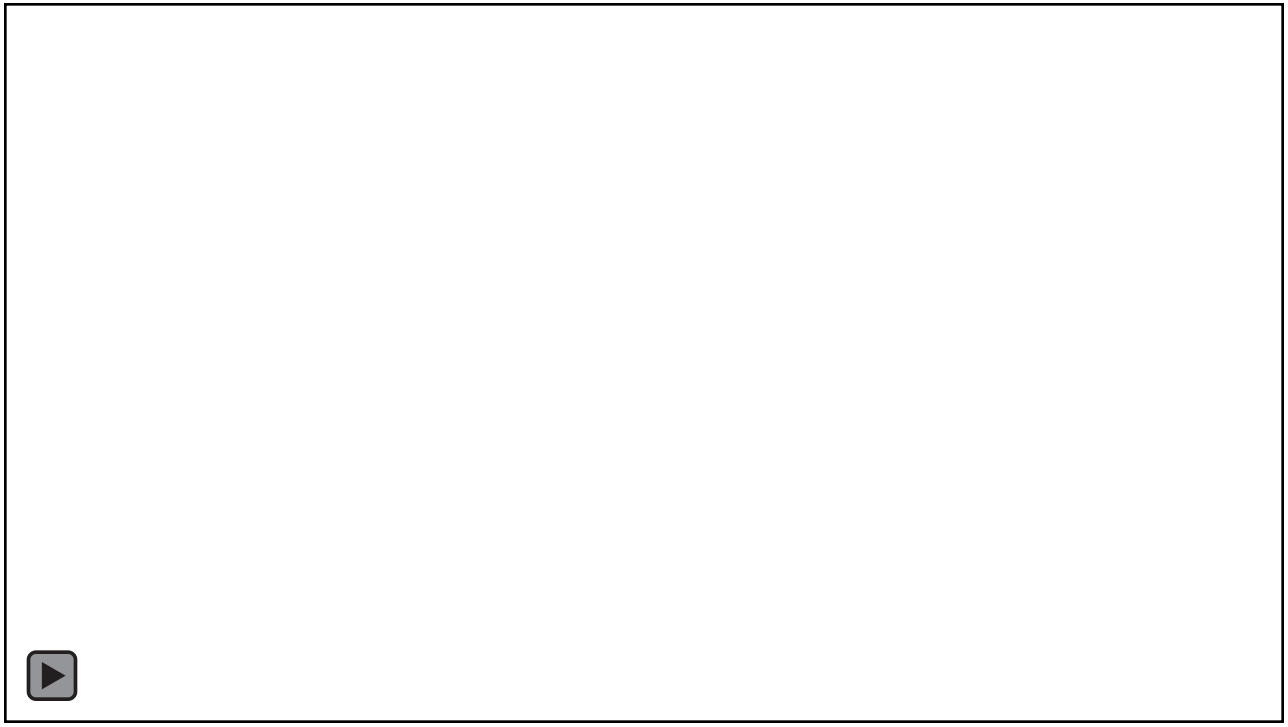
TIME

GRETA THUNBERG

THE POWER OF YOUTH

time.com

Greta Thunberg at World Economic Forum Davos January 25, 2020



Take Away Thoughts Global Energy Considerations and Update to Paris Agreement

- Climate change caused extreme weather is global
- Other GHG contribute to climate change
- Emissions follow population, primary energy source, and stage of development
- International efforts to address emissions are progressing slowly with key issues unresolved even after decades
- Some local, regional and national efforts promising
- Climate change awareness among young

The Bill