# Climate-Change Science and Policy:
## Bad News, Good News, and the Biden Agenda


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*Assistant to President Obama for Science & Technology and*
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(January 2009 – January 2017)


## Remarks for the MIT Club of Northern California

**12 November 2020**

# Outline of these remarks

Context

- Bad news from climate science
- Good news about technology and public opinion

Options

- What can be done?

History

- What did Obama and Trump do?

The path foward

- What will Biden and Harris do?

# Bad News from Climate Science

"Science is true whether or not you believe in it."

*Neil DeGrasse Tyson*

**Context: Bad news from climate science**

# Nearly all the new news from climate science has been bad news

- High-temperature records—averages and extremes—have lately been broken at unprecedented rates.
- Heat waves have become longer as well as hotter…and much more dangerous to human health.
- Droughts are also becoming longer and stronger, impacting agricultural productivity in many parts of the world.
- Even as droughts plague some regions, torrential rainfall and flooding increasingly plague many others.
- Wildfires have become much bigger and hotter, while propelling health-harming smoke over large distances.
- Since 2012, virtually every ocean basin susceptible to typhoons or hurricanes has experienced the strongest ones on record.

Context: Bad news from climate science

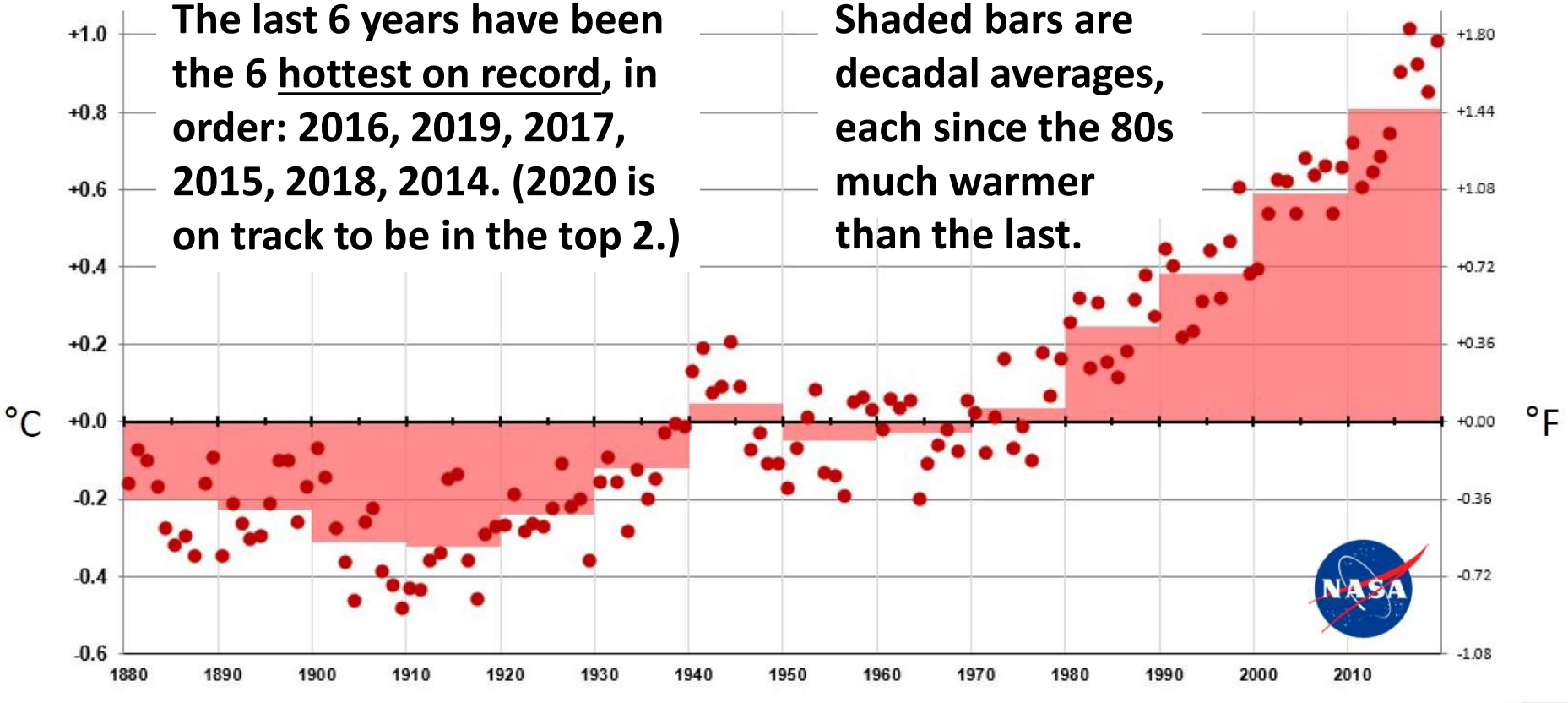
# Global average temperature rising steeply

**Global average surface temperature anomalies 1880-2019**

Baseline is 1950-1981 average

**The last 6 years have been the 6 hottest on record, in order: 2016, 2019, 2017, 2015, 2018, 2014. (2020 is on track to be in the top 2.)**

**Shaded bars are decadal averages, each since the 80s much warmer than the last.**




**Anthropogenic warming has dominated natural variability and the cooling influence of anthropogenic particles since around 1975.**

**Context: Bad news from climate science**

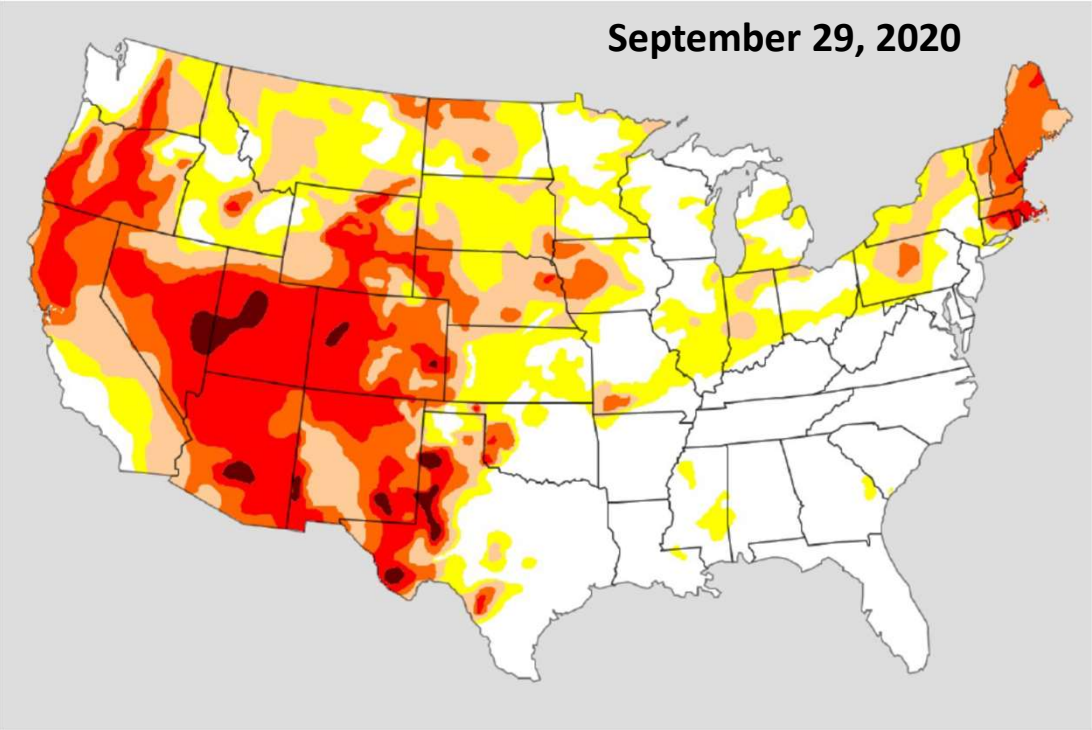
# Heat records being shattered everywhere

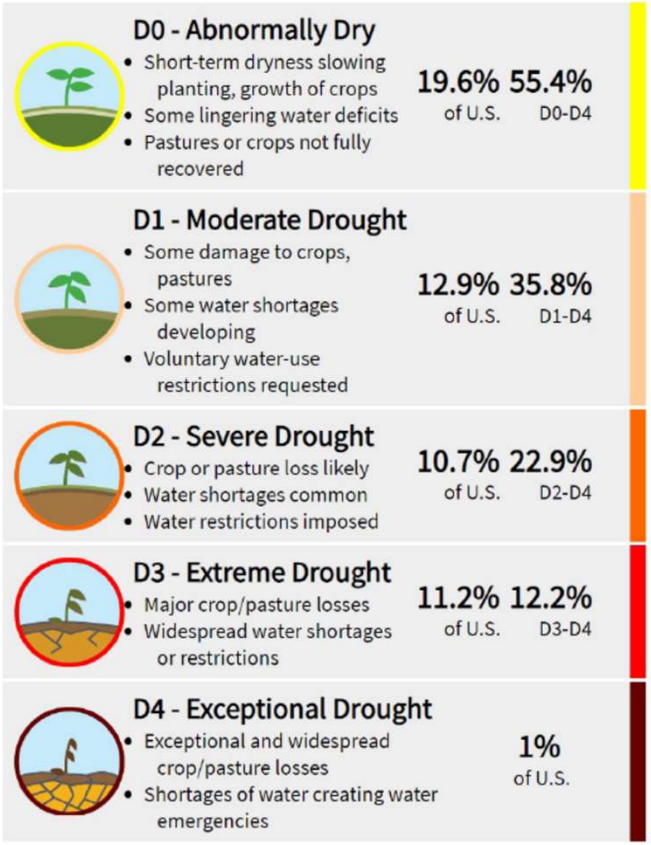
All-time record high temperatures in 2016-2020

| | | | |
|---|---|---|---|
| • Death Valley, CA | 130°F | / 54.4°C | Aug 2020 |
| • Iran | 129°F | / 53.9°C | June 2017 |
| • India | 128°F | / 53.3°C | May 2016 |
| • South Africa | 122°F | / 50.0°C | Nov 2018 |
| • Spain | 117°F | / 47.2°C | July 2017 |
| • Chile | 113°F | / 45.0°C | Jan 2017 |
| • France | 109°F | / 42.8°C | July 2019 |
| • China | 106°F | / 41.1°C | July 2017 |
| • Cambridge, UK | 102°F | / 38.9°C | July 2019 |
| • Siberia | 100°F | / 38.0°C | Jun 2020 |

**Context: Bad news from climate science**

# Worsening drought




<u>Climate-related causes</u>

1. Higher temperatures = bigger losses to evaporation.
2. More of the rain falling in extreme events = more loss to flood runoff.
3. More rain, less snow in mountains = more runoff in winter, less in summer.
4. Earlier spring snowmelt also = less runoff for summer.
5. Altered atmospheric circulation patterns also play a role.

Nat'l Centers for Environmental Information 2020

Context: Bad news from climate science

# More flooding resulting from bigger downpours

**Warmer atmosphere holds more water, so more can & does come down at one time. Slower-moving storm systems further increase the downpours.**

**"Hundred-year" floods now occur once a decade or more in many places.**

**Three "five-hundred-year" floods occurred in Houston in three years.**

**USA, Europe, India, Japan, and Africa were all hit hard in 2018, 2019, & 2020.**

Tim Gruber for the New York Times

Hamburg, Iowa, March 2019

DAVE DILDINE/WTOP/ASSOCIATED PRESS

Canal Rd, Washington DC, July 2019

**Context: Bad news from climate science**

# Worse wildfires

- US fire season ≥3 months longer than 40 years ago.
- Average fire much bigger & hotter than before.
- Nine of 10 biggest U.S. wildfires took place since 2004 (the other in 1997).
- Across the Arctic, even the tundra is burning.
- Smoke from today's big fires harms health over huge areas.
- California today is the canary in the coal mine.


**Context: Bad news from climate science**

# Bigger tropical storms

- 10/12: Sandy, largest ever in Atlantic
- 11/13: Haiyan, strongest ever in N Pacific
- 10/15: Patricia, strongest ever worldwide
- 02/16: Winston, strongest ever in S Pacific
- 04/16: Fantala, strongest ever in Indian Ocean
- 10/17: Ophelia, strongest ever in E Atlantic
- 09/19: Dorian, strongest ever in N Atlantic



**A record 29 named tropical storms in the Atlantic Basin in 2020 so far!**

**Context: Bad news from climate science**

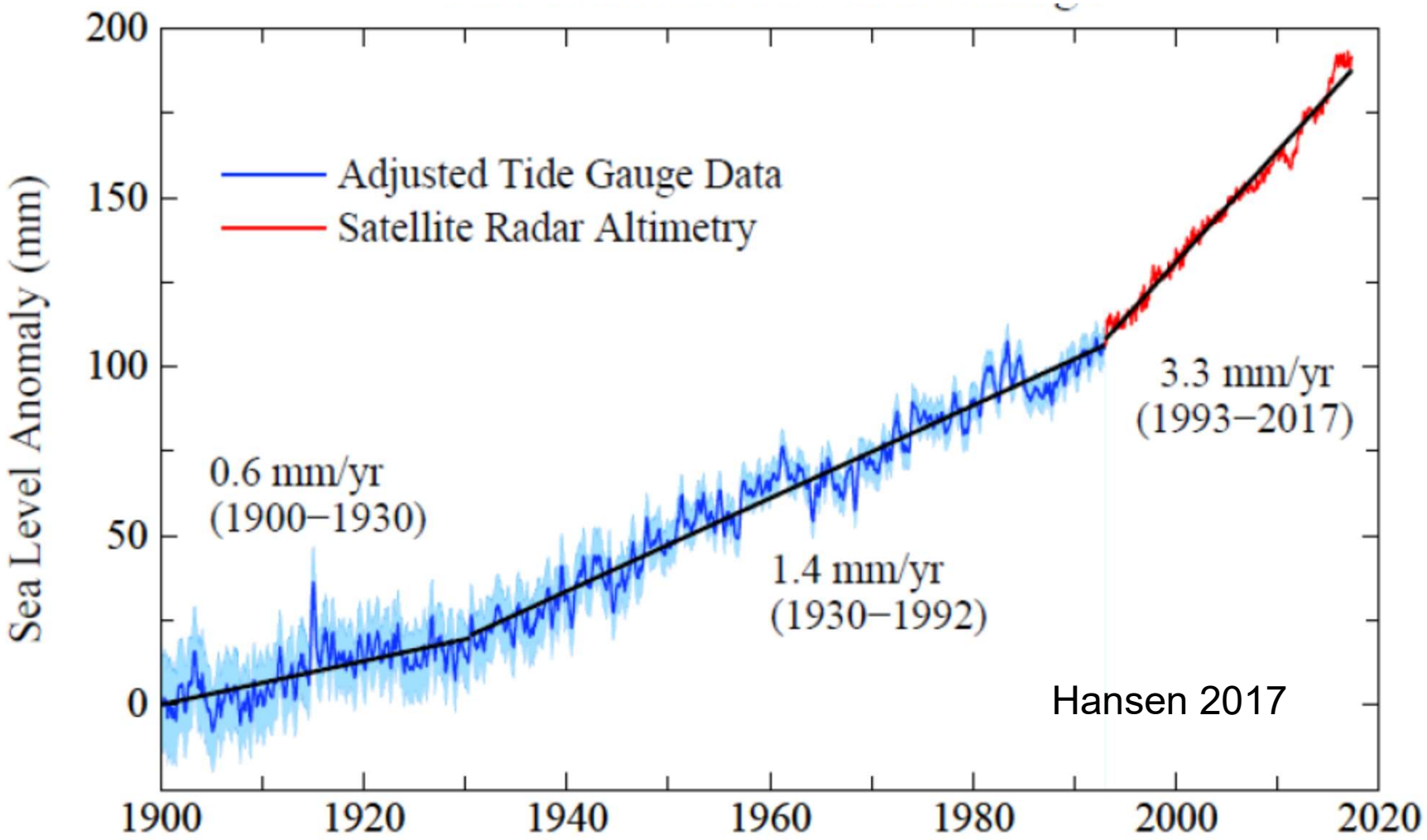
## Nearly all the new news from climate science has been bad news (continued)

- Sea-level rise has accelerated, making the storm surges from those tropical cyclones bigger & more destructive and putting coastal communities at greater risk of inundation.
- Fish and shellfish are suffering increasingly from the combination of ocean warming, oxygen depletion, and acidification.
- The world's coral reefs, the 2nd largest source of biodiversity on the planet, have been particularly hard-hit; more than half of them likely to be gone by 2050.
- Growing scientific knowledge about the emissions of carbon dioxide and methane from thawing permafrost indicate those emissions alone may make it impossible to limit global-average warming to 2 degrees C above the pre-industrial level.

**Context: Bad news from climate science**

# Accelerating sea-level rise

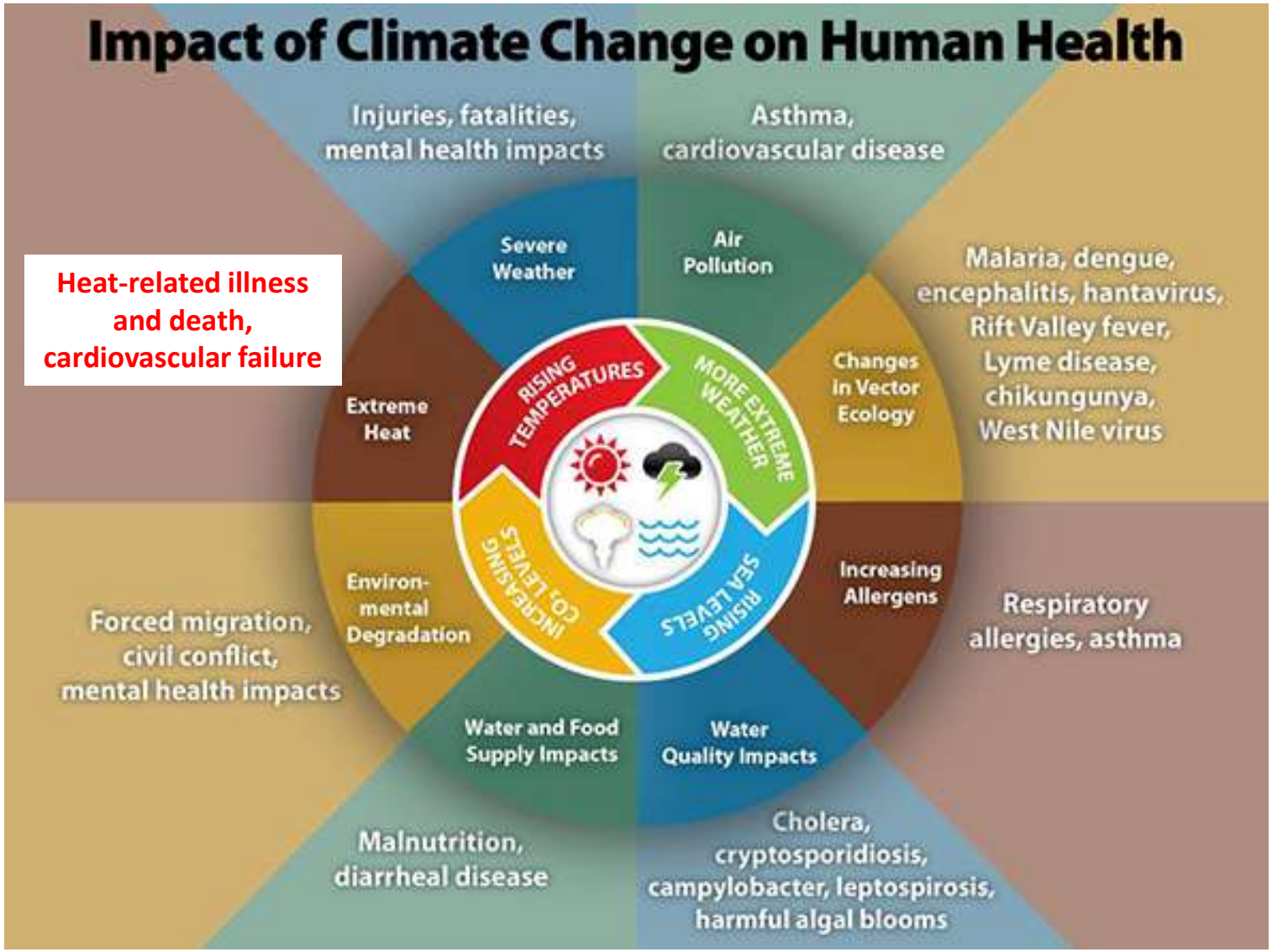
Sources are glacier & ice-sheets shrinkage, thermal expansion, groundwater mining




**Looking just at post-2010, the rate is 5.5 mm/yr!**

**Context: Bad news from climate science**

# Climate change is already harming human health



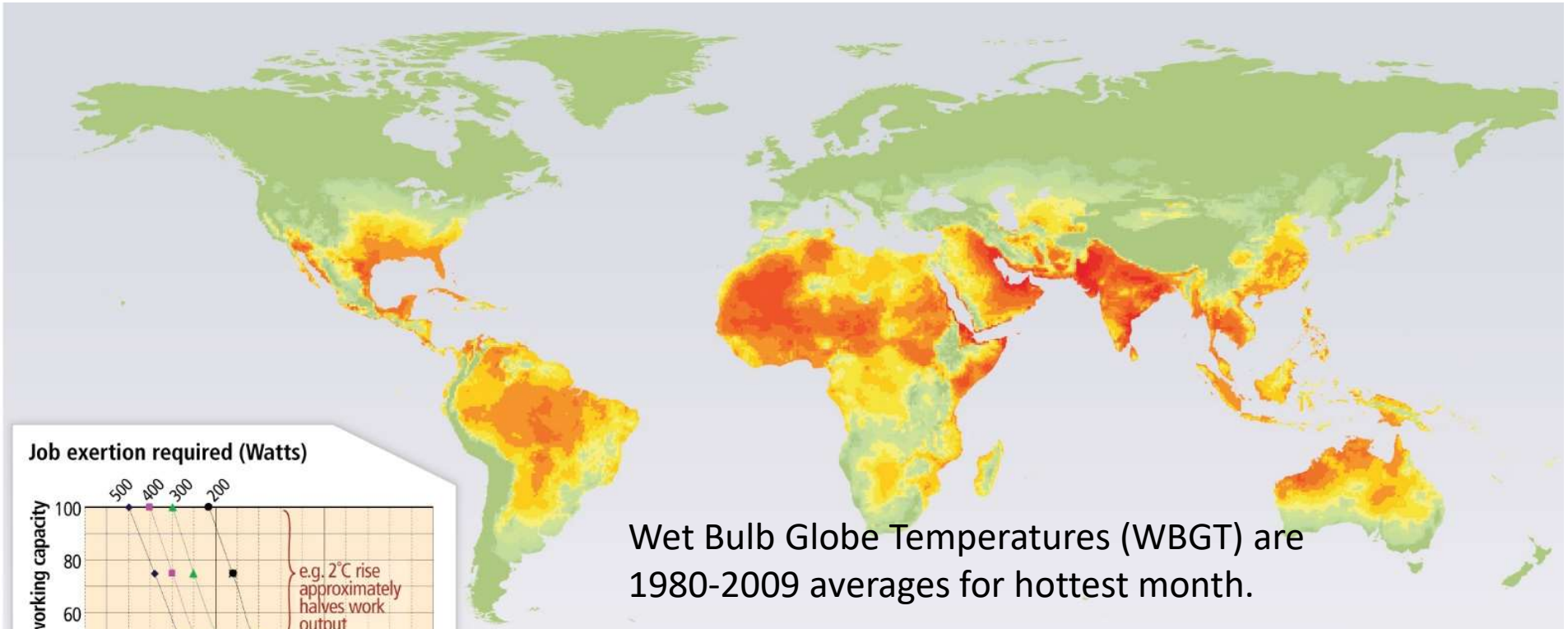

Recent evidence documents climate-linked worsening in most of these categories.

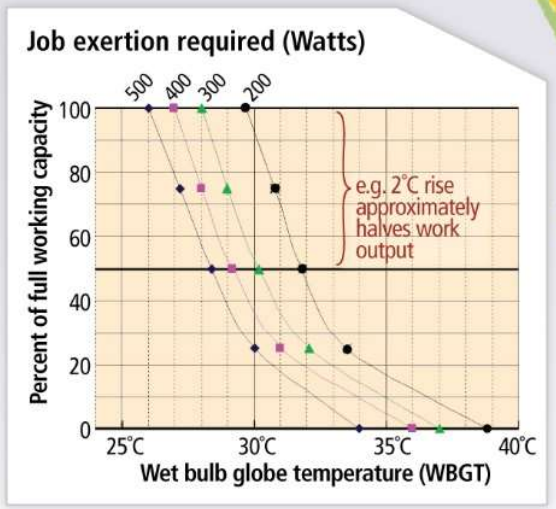
See, *e.g.*, The *Lancet* Count-down on Health, 13 Nov 2019

Centers for Disease Control & Prevention 2018

Context: Bad news from climate science

# Wet bulb globe temperature correlates with loss of capacity to work and risk of heat stroke



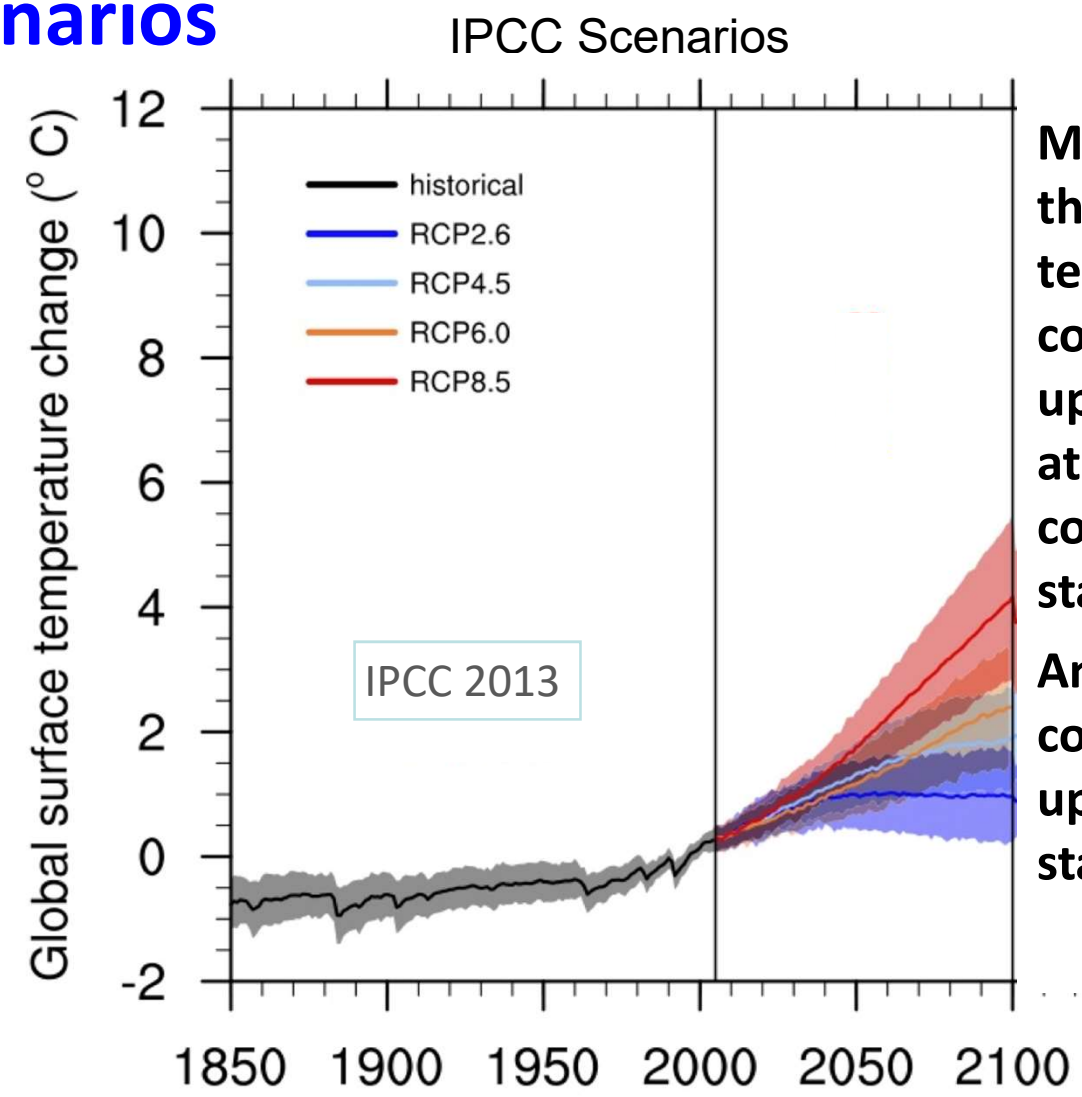

IPCC AR5, WGII, Figure 11-5

**The area of the world afflicted with high WBGT is now increasing rapidly.**

Context: Bad news from climate science

# It's going to get worse: Global T increases continue under all scenarios

The range of possible futures considered by the Intergovernmental Panel on Climate Change (IPCC) extends from early deep emission reductions (blue) to continued "Business as Usual" (red). Global ΔT goes to ~2°C from today's ~1°C even if emissions are low .




Momentum in the climate system means T continues to go up even after atmospheric conditions stabilize.

And sea level continues to go up even after T stabilizes.

How <u>much</u> worse it gets depends above all on what we do about it.

**Context: Bad news from climate science**

## Absent big emission cuts, we can expect…

- Large further increases in deadly heat waves
- Destruction of most of the world's coral reefs
- Wider disruption of marine food webs/fisheries
- Big further expansion in area burned by wildfires
- Still bigger torrential downpours & more flooding
- More Cat 3-5 hurricanes/typhoons making landfall
- Further increases in frequency & intensity of droughts
- Accelerating sea-level rise, reaching 1 m (3.3 ft) by 2100
- Falling agricultural yields for corn, wheat, rice, soybeans
- More sickness & death from heat stress, tropical diseases

**And, as a result, much bigger flows of environmental refugees**

# Good News About Technology and Public Opinion

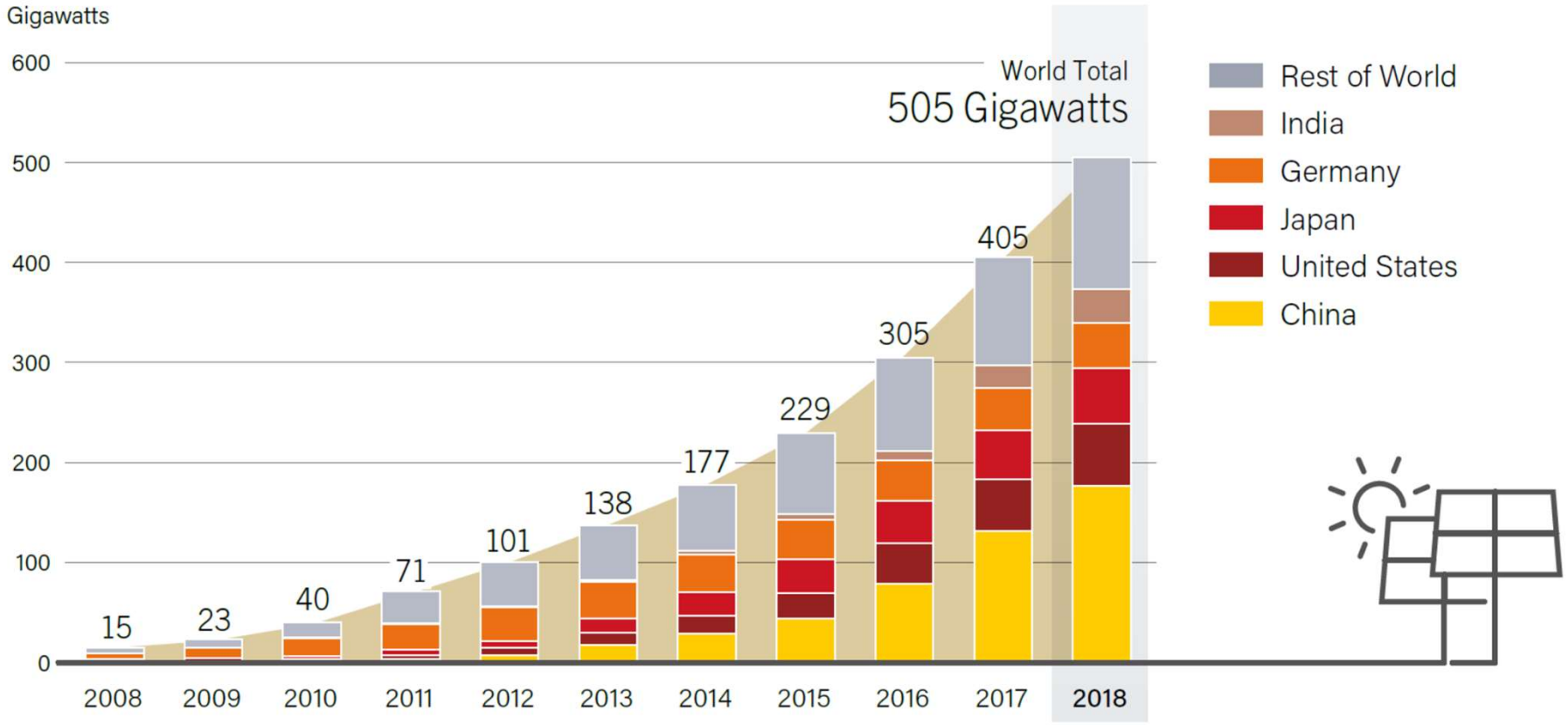
"The world is waking up."

*Greta Thunberg, UN Speech, September 2019*

**Context: Good news about technology**

# Renewables: Costs down, growth up

FIGURE 26. Solar PV Global Capacity, by Country and Region, 2008-2018

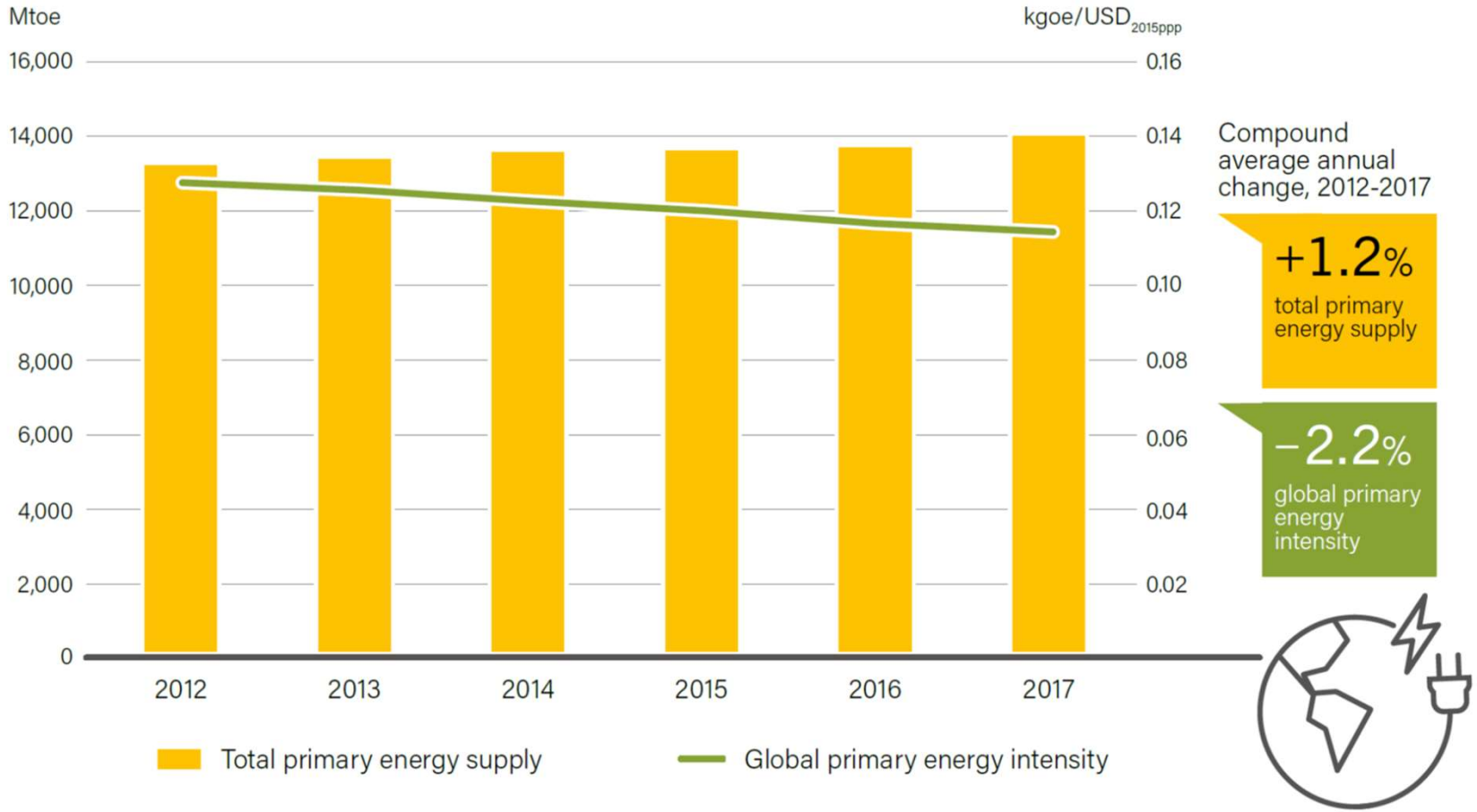



**Wind capacity is also continuing to expand rapidly.**

Renewables 2019: Global Status Report

**Context: Good news about technology**

# Falling energy intensity of the world economy




**Potential to increase the rate of decline of E/GDP is large.**

Renewables 2019: Global Status Report

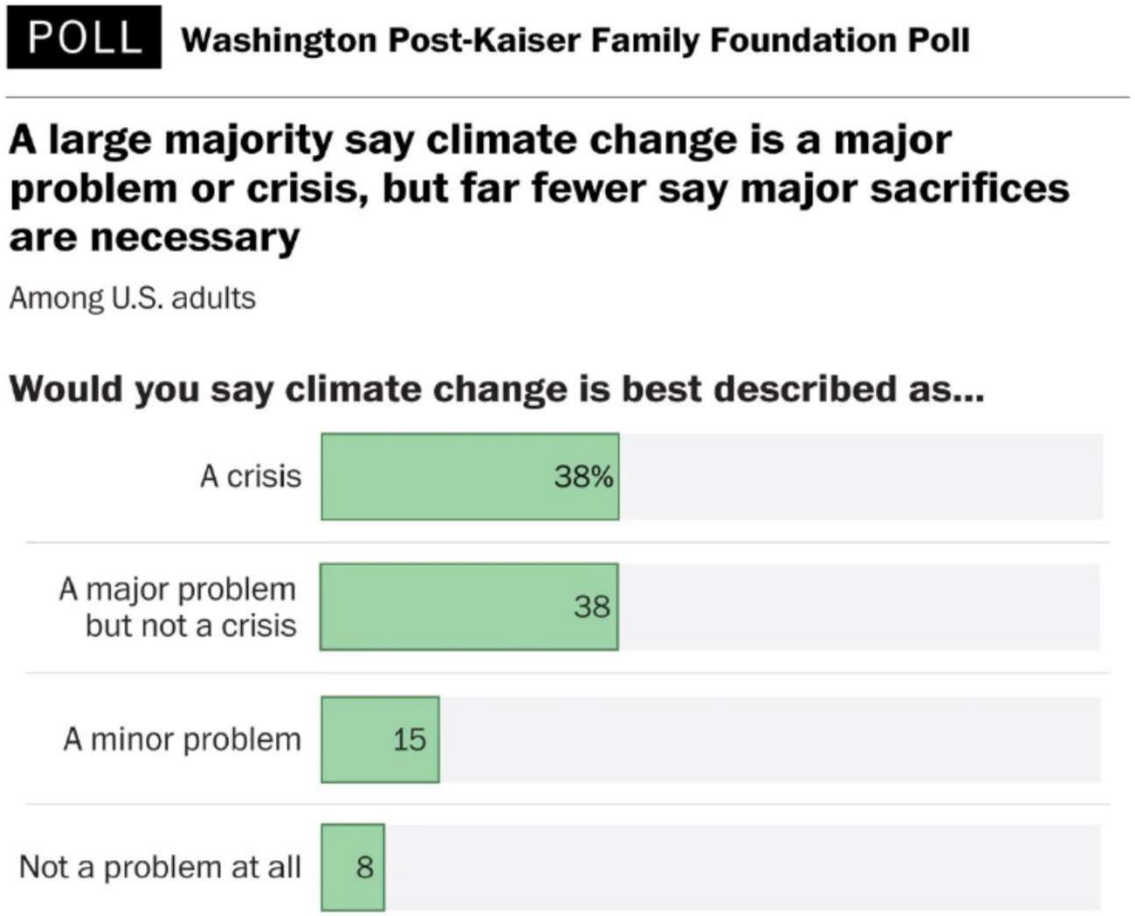
**Context: Good news about technology**

# Other important technological advances

- Costs of offshore wind, with huge generation potential, have been coming down sharply.
- Performance of batteries, both for vehicles and in stationary applications, has been improving impressively (increasing attraction of electric vehicles and widening expansion opportunities for renewable electricity).
- Significant progress is being made toward making carbon capture / utilization / storage (CCUS) affordable (assuming a carbon price > \$30/t$CO_2$)
- Some advanced nuclear-reactor types may be less expensive than current types *and* safer.

**Context: Good news about public attitudes**

# Rising public understanding in the United States




- 76% say climate change is a "crisis" or a "serious problem".
- About 80% say human activity is driving climate change.
- These numbers are up substantially in just the past 5 years.

Washington Post, 13 September 2019

**In most other countries, public is even <u>better</u> informed about climate change.**

# Options in the Face of the Climate-Change Challenge

"Trend is not destiny."

Rene Dubos

**Options**

# Society has only three options

- Mitigation, meaning measures to reduce the pace & magnitude of the changes in global climate being caused by human activities.
- Adaptation, meaning measures to reduce the adverse impacts on human well-being resulting from the changes in climate that do occur.
- Suffering the impacts and societal disruption that mitigation and adaptation fail to avoid.

**We're already doing some of each. What's at stake is the future mix.**

**Minimizing suffering will require maximizing both mitigation and adaptation.**

**Options**

# Mitigation possibilities include…

CERTAINLY

- Reduce emissions of greenhouse gases & soot from the energy sector **(the clearest, largest leverage)**
- Reduce deforestation; increase reforestation & afforestation
- Modify agricultural practices to reduce emissions of greenhouse gases & build up soil carbon

**Some will be costly, but less so than unmitigated climate change.**

CONCEIVABLY

- "Scrub" greenhouse gases from the atmosphere technologically **(very high cost)**
- "Geo-engineering" to create cooling effects offsetting greenhouse heating **(limited efficacy, possible side effects)**

Options

## Adaptation possibilities include…

- Developing heat-, drought-, and salt-resistant crop varieties
- Strengthening public-health & environmental-engineering defenses against tropical diseases
- Preserving & enhancing “green infrastructure” (ecosystem features that protect against extremes)
- Preparing hospitals & transportation systems for heat waves, power outages, and high water.
- Building dikes & surge barriers against sea-level rise
- Avoiding further development on flood plains & near sea level (and retreating from existing low-lying infrastructure that is undefendable)

**Many would make sense in any case even absent climate change.**

**Options**

# How much mitigation is needed to avoid disaster?

- The community of nations agreed in 2009 on a goal of holding the increase in global average surface temperature to 2°C (3.6 °F) above the pre-industrial level.
- That target was picked not because it would keep the world "safe", but because it was the lowest figure experts thought might be achievable.
- The adverse impacts already being experienced at today's 1°C led the hardest-hit countries to argue in 2015 in Paris that 2°C would be devastating and the world should aim for 1.5°C.
- The October 2018 IPCC report on a 1.5°C target underscored this but noted the lower goal would require very steep emissions reductions worldwide starting almost immediately.

# Climate-Change Research & Policy Under Obama and Trump

"The threat of climate change is serious, it is urgent, and it is growing." Barack Obama, September 2009

"I don't know that it's man-made…I don't wanna give trillions and trillions of dollars." Donald Trump, October 2018

# The climate-energy nexus under Obama

- A deeply qualified climate-energy team
- $80 billion for clean & efficient energy in the Recovery Act
- $100s of millions for Advanced Research Projects Agency-Energy (ARPA-E) and five new Energy Innovation Hubs
- Continuing annual budgets constrained under pressure from Congress, but energy & climate R&D protected
- First-ever fuel-economy/$CO_2$ tailpipe standards for light-duty vehicles, plus fuel-economy standards for trucks
- First gov't calculation & use of Social Cost of Carbon
- Elevation of climate adaptation, preparedness, resilience
- Climate Action Plan, coordination w China→Paris agreement

# Obama's Climate Action Plan

- Mitigation in the United States
  - Clean Power Plan to reduce $CO_2$ emissions from coal power plants
  - Strategy & regulations to reduce methane & HFC emissions
  - Doubling down on renewables, end-use efficiency, grid
- Adaptation in the United States
  - Agencies to integrate adaptation into all policies & programs
  - Interagency Council & State/Local Tribal Leaders Task Force
  - Standards & partnerships for flood, drought, wildfire, crop, and urban resilience
- International support for mitigation & adaptation
  - U.S.-China agreement (11-14) → Paris Accords (12-15)
  - Partnerships & commitments for mitigation/adaptation assistance
  - Mission Innovation: 20 countries to double clean-energy R&D

# What Trump has done

- Appointed climate-change deniers & wafflers to key posts…
  - Mulvaney at OMB; Pruitt & then Wheeler at EPA; Zinke & then Bernhardt at Interior; Pompeo at State; Happer in NSC
- Rescinded all of Obama's Executive Orders on climate change
  - Clean Power Plan: coal-plant emissions, methane strategy
  - Climate-change adaptation: USA and international
  - Social Cost of Carbon in gov't decision-making
- Rejected Paris, immediately stopping all measures to comply
- Repeatedly proposed big cuts in energy R&D, climate science, other S&T

**All of this has stimulated an exodus of many of the Federal government's most talented climate scientists & analysts, particularly from EPA, Department of Interior, Department of State.**

# The Agenda for Climate Science and Policy in the Biden-Harris Administration

"Between fatalism and complacency lies urgency."

*Jake Sullivan, National Security Advisor to Vice President Biden*

**Biden-Harris**

# The specific actions the world needs now

- A massive program of technological innovation on clean energy and energy efficiency, featuring partnerships among nations, government agencies, firms, & universities, and including…
  - Modernized electricity grids
  - Green hydrogen technologies
  - Reduced methane leaks throughout the energy system
  - Sustainable biofuel production for power plants & aviation
  - More economical wind & solar and better electricity storage
  - $CO_2$ capture & sequestration for fossil & biomass power plants
  - Safer & more affordable nuclear fission & practical nuclear fusion
- A similarly massive set of international public-private-university partnerships focused on developing & implementing adaptation measures to limit the harm from the changes in climate that can no longer be prevented.

**Biden-Harris**

# **What is needed now** (coninued)

- The United States government should…and Biden-Harris will…
  - — repopulate key positions across the White House, EPA, NOAA, NASA, Interior, State, Energy, etc. with capable, climate-savvy leaders
  - — rejoin the Paris Agreement--and restore the measures to comply with it--that Trump dismantled, specifically…
  - — restore the provisions of Obama's 2013 Climate Action Plan and associated Executive Orders and budgets on mitigation, adaptation, and the basic science that must underpin both;
  - — give early priority to measures that create economic opportunity and address climate-change impacts on the most vulnerable;
  - — resume US assistance for mitigation & adaptation in countries in need, in magnitudes to make up for lost time; and
  - — rebuild US international collaboration on climate monitoring and advanced mitigation and adaptation options.

**Questions, Comments, Cries of Outrage?**