

Energy made from fossil fuels warms our planet.



Climate Change

Dr. Loraine Lundquist

What is climate change all about?

- What kind of climate change are we experiencing now? *It's warming.*
- What is causing that change? *It's us.*
- How sure are we about what's causing it? *We're sure.*
- What are/will be the effects of that change? *It's bad.*
- What can we do to prevent those effects? *We can fix it.*

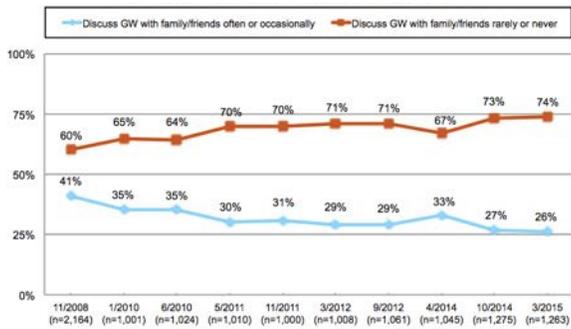
Leonardo DiCaprio acceptance speech this week
Oscar for Best Actor



5 Key Points about Climate Change:

- It's warming
- It's us
- We're sure
- It's bad
- We can fix it

74% of Americans say they “rarely or “never” discuss global warming with family and friends.

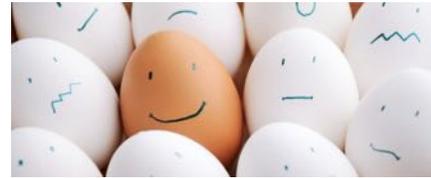


<http://environment.yale.edu/climate-communication-OFF/files/Global-Warming-CCAM-March-2015.pdf>

How do you **feel** when you think about climate change?

Despair
“What is our world coming to?”

Judgment
“But what kind of a car do **you** drive?”



Guilt
“But I just really **enjoy** taking long hot showers.”

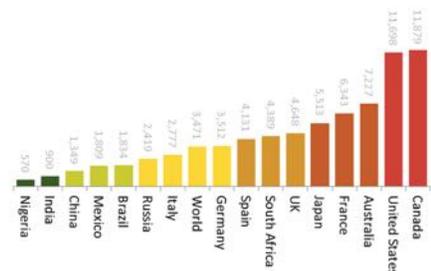
Hopelessness
“But what can we as students **do**?”

5 Key Points about Climate Change:

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We could be comfortable with a lot less energy use.

Household Electricity Consumption (kWh/year)



Note: Figures are 2010 averages for electrified households
Source: Enerdata via World Energy Council

Shrink That Footprint

We already have all the technology we need to stop using fossil fuels.

50 STATES | 50 PLANS | 100% RENEWABLE ENERGY BENEFITS

\$600 billion avoided health care costs by 2050.

\$3.3 trillion in avoided climate change costs by 2050.

“Barriers to the plan are primarily social and political, not technological or economic.”

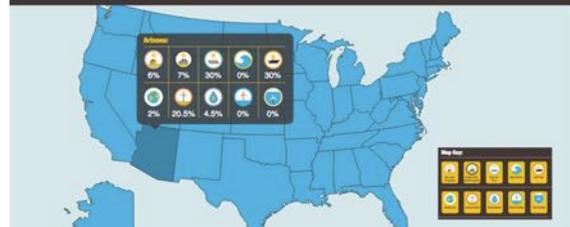


<http://thesolutionsproject.org>

Mark Jacobson & team at Stanford:
detailed plans for all 50 states: 100% renewable energy by 2050

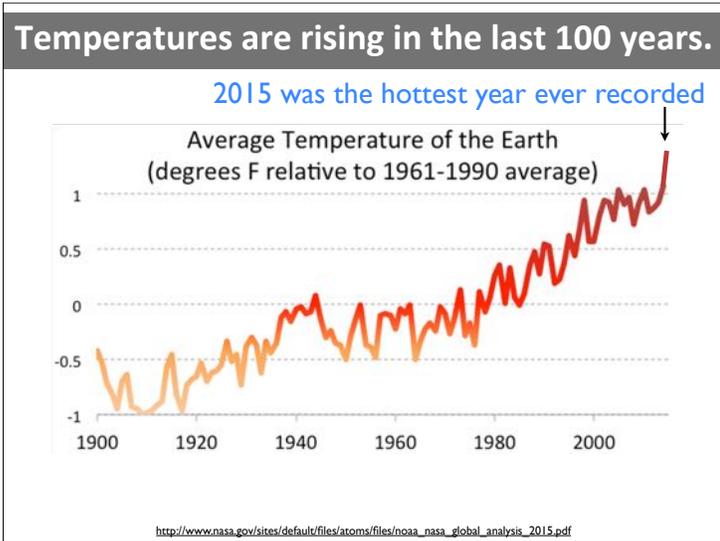
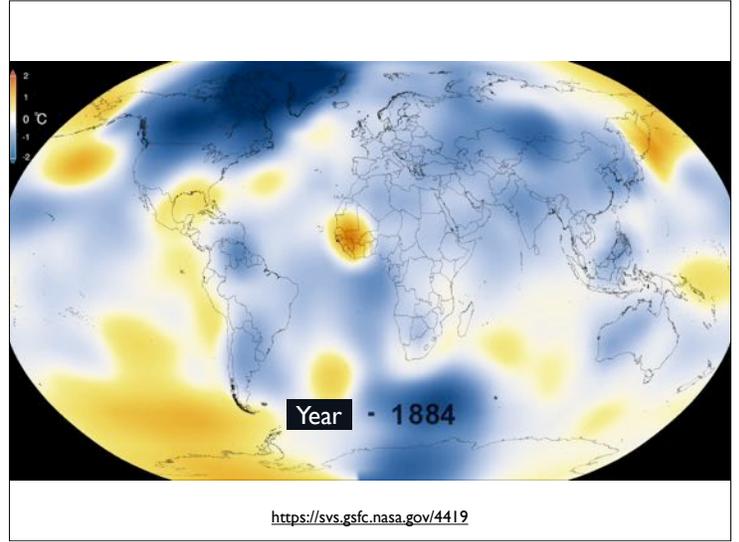
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50 STATES | 50 PLANS | 100% RENEWABLE ENERGY BENEFITS



<http://thesolutionsproject.org/infographic/>

Mark Jacobson & team at Stanford:
detailed plans for all 50 states: 100% renewable energy by 2050



Not everyone "believes" it's warming.

Donald J. Trump @realDonaldTrump

The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.

2:15 PM · 6 Nov 2012

5,328 retweets · 1,525 likes

Donald J. Trump @realDonaldTrump

This very expensive GLOBAL WARMING bullshit has got to stop. Our planet is freezing, record low temps, and our GW scientists are stuck in ice

2,044 retweets · 1,169 likes

4:39 PM · 1 Jan 2014

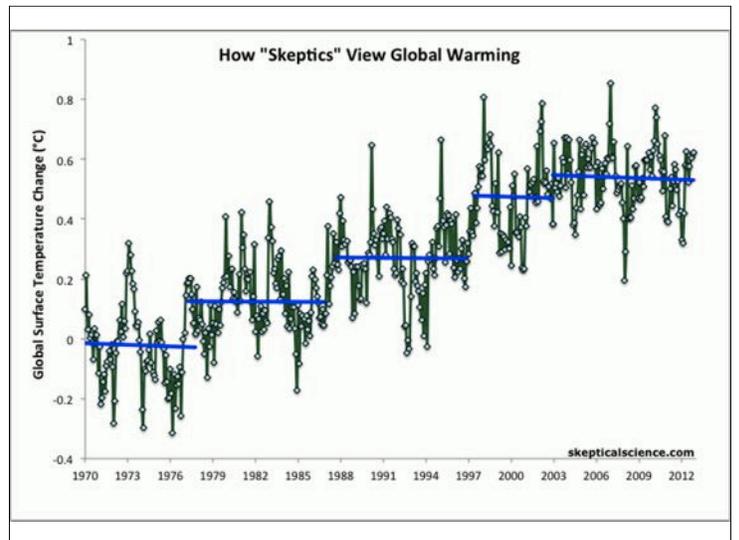
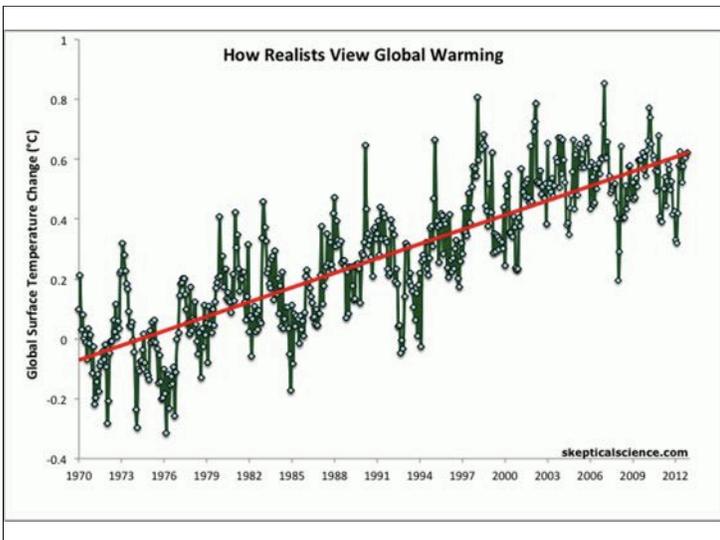
"For the past 18 years, weather satellites have not measured a global increase in temperatures although carbon dioxide (CO2) in the atmosphere has increased over that same period."

Rep. Lamar Smith
Chair of US House Comm. on Science, Space, and Technology

Sen. James Inhofe
Chair of US Senate Comm. on Environment and Public Works

THE GREATEST HOAX

U.S. SENATOR JAMES INHOFE

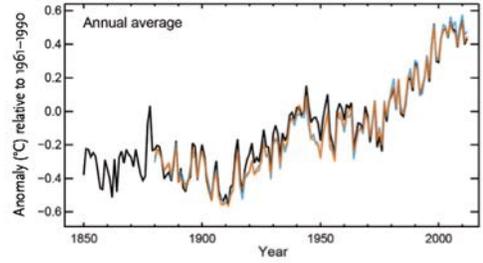


There are 13 independent indicators of warming.



<http://www.skepticalscience.com/graphics.php?g=8>

Temperatures are rising in the last 100 years.
2015 was the hottest year on record



It's risen about 1°C (1.8°F) over pre-industrial levels.

Climate Change Evidence and Causes: An overview from the Royal Society and the US National Academy of Sciences: <http://rdsb.royalsoc.ac.uk/pressroom/pressroom/office/other/climate-change-14.pdf>

There are 13 different independent indicators that the world is warming.



<http://www.skepticalscience.com/graphics.php?g=8>

Glaciers are receding.



Columbia glacier in Alaska

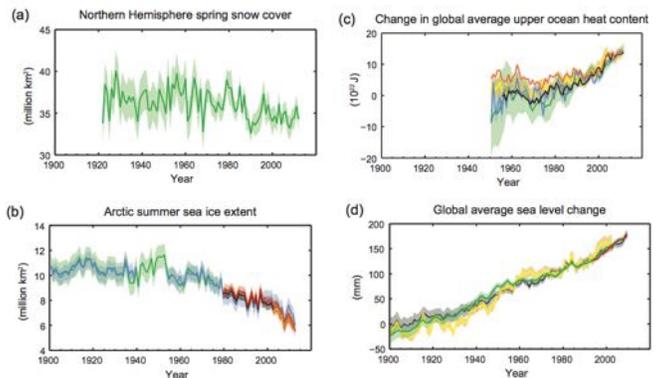
<http://www.fox.com/2009/09/23/this-is-how-much-the-glacier-has-receded>

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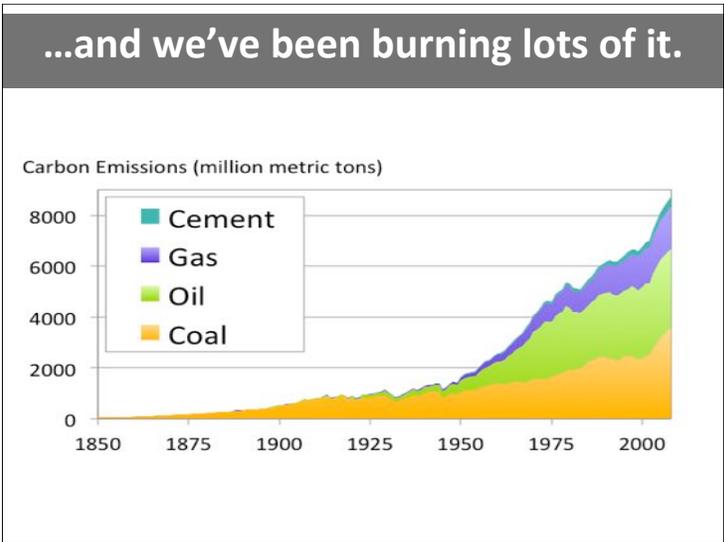
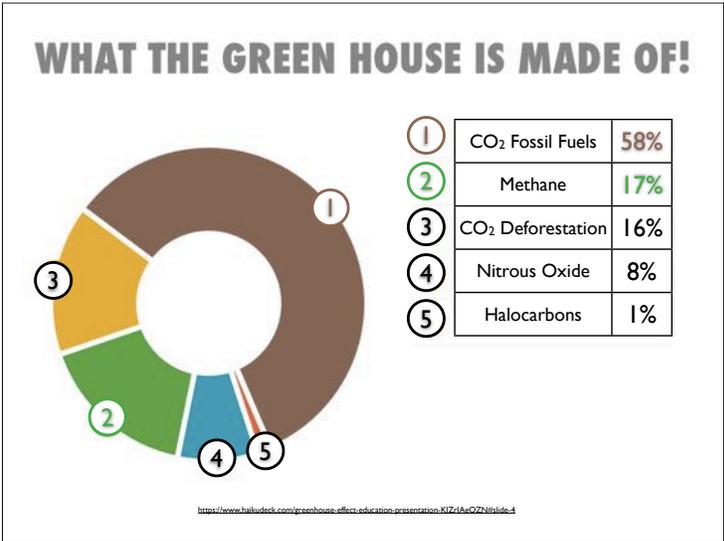
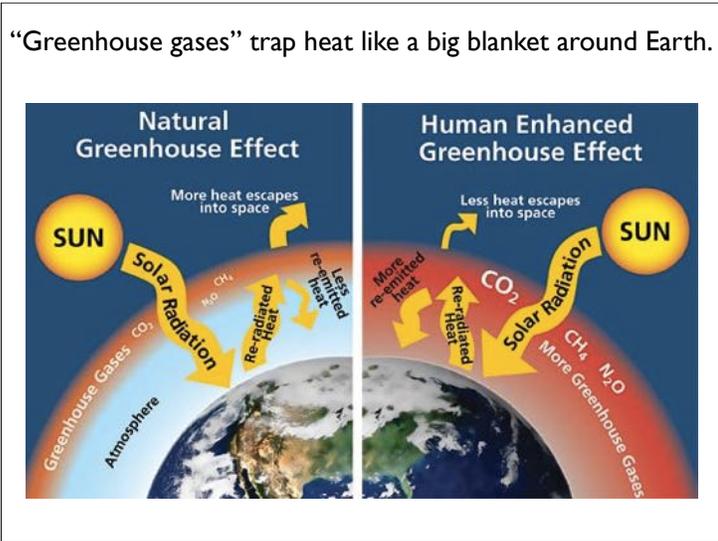


<http://www.skepticalscience.com/graphics.php?g=8>

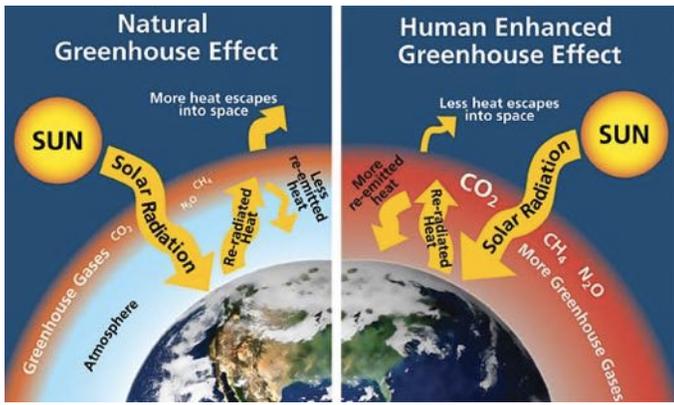
Other variables besides temperature indicate warming.



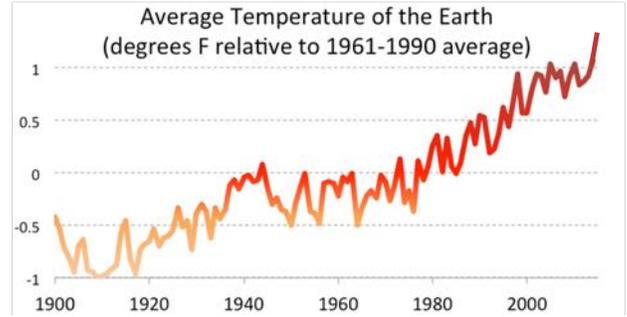
<http://www.aacsbsearc.org/>



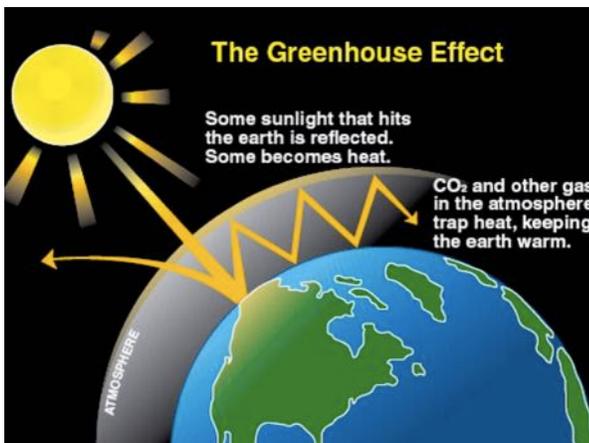
“Greenhouse gases” like CO₂ trap heat like a big blanket.



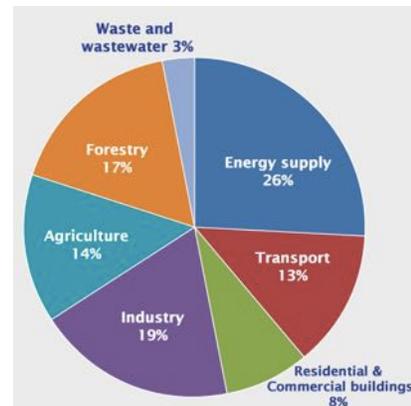
And that's why the Earth is warming.



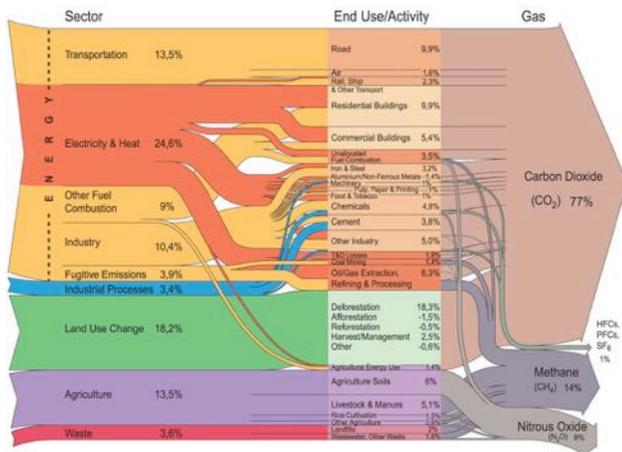
“Greenhouse gases” trap heat like a big blanket around Earth.



Greenhouse effect is primarily caused by burning fossil fuels for electricity and transportation.

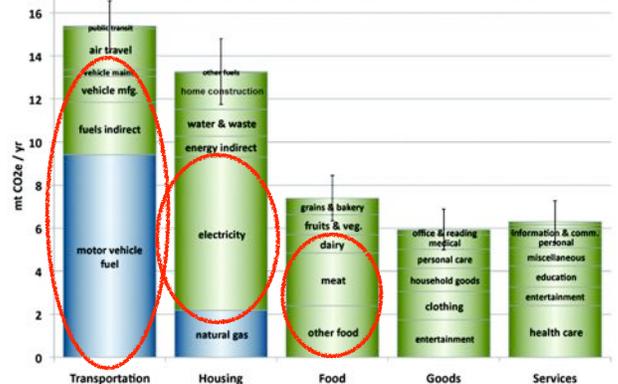


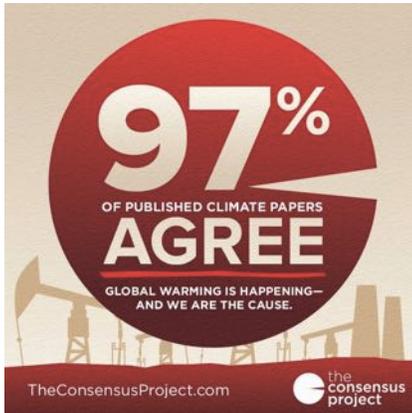
World Greenhouse gas emissions by sector



Our personal contribution comes primarily from driving, electricity, and food.

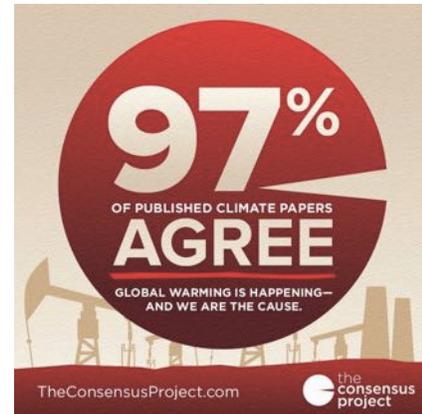
Carbon Footprint of Typical U.S. Household: 48 Tons per Year





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- It's us
- **We're sure**
- It's bad
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97% of scientific papers published on climate change agree: Global warming is happening -- and we are the cause.



Scientists quantify their uncertainty.

Intergovernmental Panel on Climate Change

259 authors in 39 countries

“It is extremely likely [$>95\%$ probability] that human influence has been the dominant cause of the observed warming since the mid-20th century”



10 “human fingerprints” indicate the warming is not natural.



<http://www.skepticalscience.com/big-picture.html>

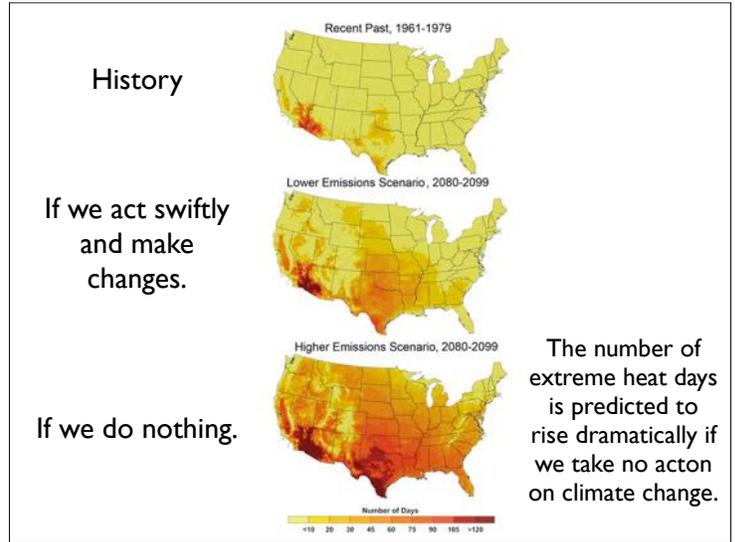
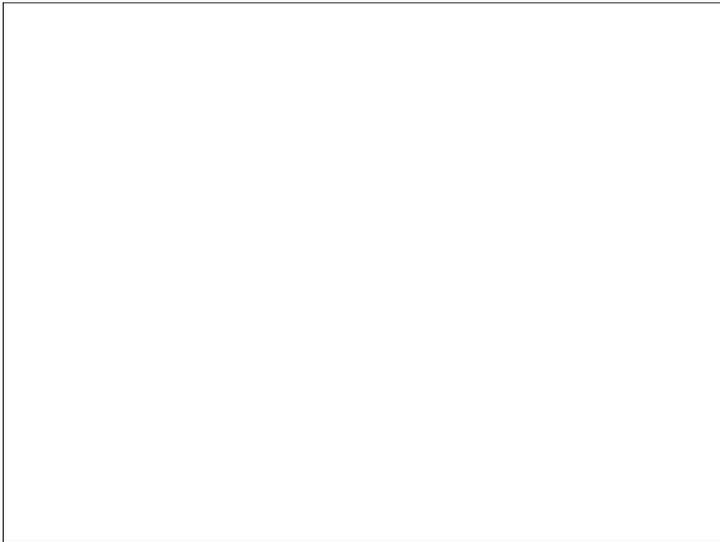
IPCC 2014 Report (AR5)

- IPCC = Intergovernmental Panel on Climate Change
 - The world's foremost body on climate change
 - 259 authors in 39 countries
- “Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia.”
- “It is extremely likely [$>95\%$ probability] that human influence has been the dominant cause of the observed warming since the mid-20th century”



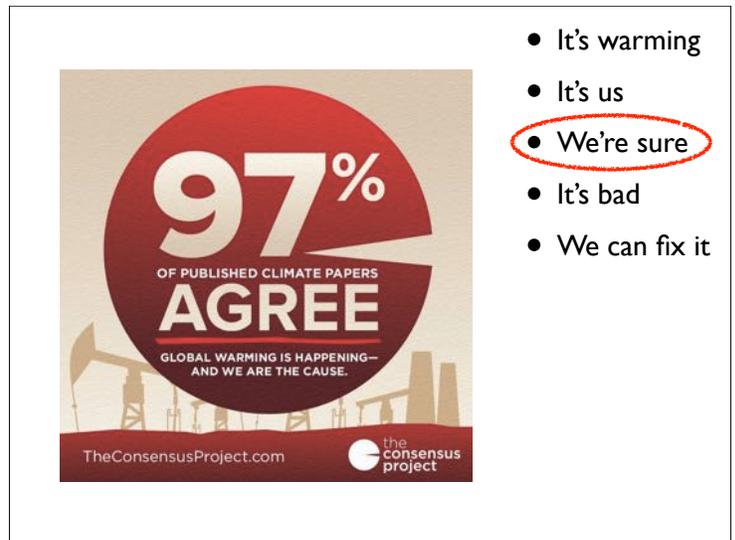
<http://www.ipcc.ch/report/ar5/>

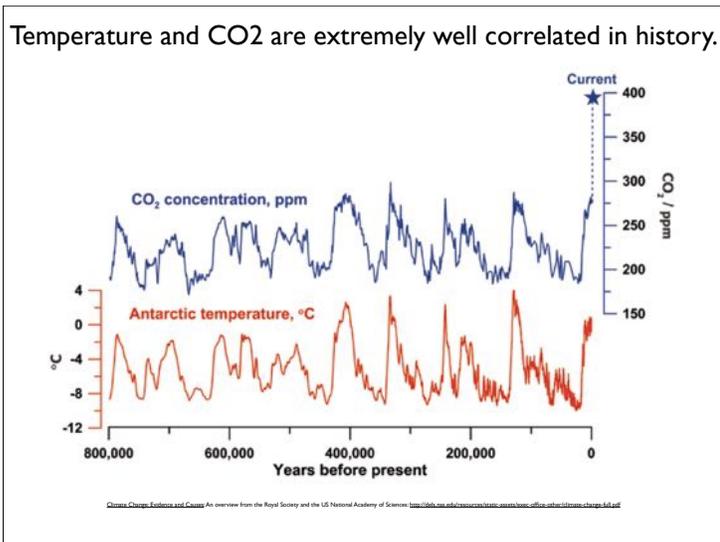




Discuss with the person next to you:

What was it like to talk about climate change with people you don't usually talk about it with?

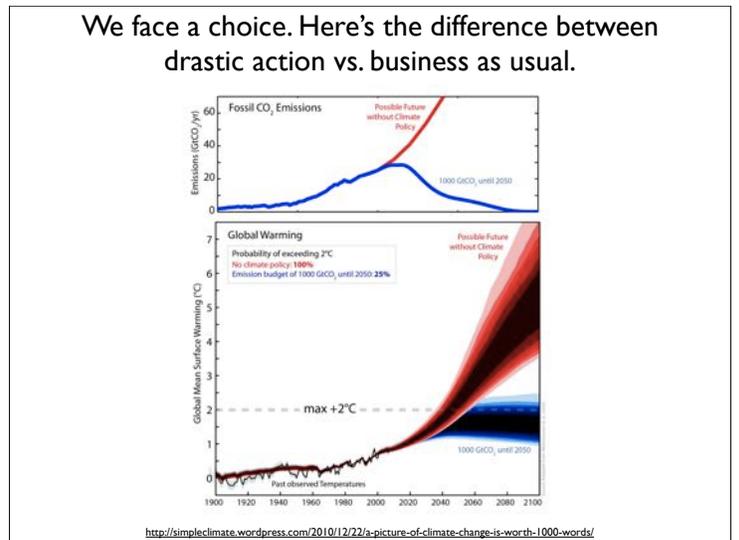




The Great Barrier Reef experienced a massive bleaching and die-off event this year.

The Washington Post
'And then we wept': Scientists say 93 percent of the Great Barrier Reef now bleached

<https://www.theguardian.com/environment/2016/jun/07/the-great-barrier-reef-a-catastrophe-laid-bare>



When Earth was 4 degrees cooler, NY was under 1 mile of ice (20 times more than this picture)

↓ 4°C Cooler

↑ 4°C Warmer



x 20 times thicker ice than this picture



Changes happening today are beginning to lock in sea level rise that will continue for centuries.



North America in the Middle Miocene, fifteen million years ago when temperatures were several degrees warmer and sea level was up to 40m higher than at present.

Could this be New York in 2100?

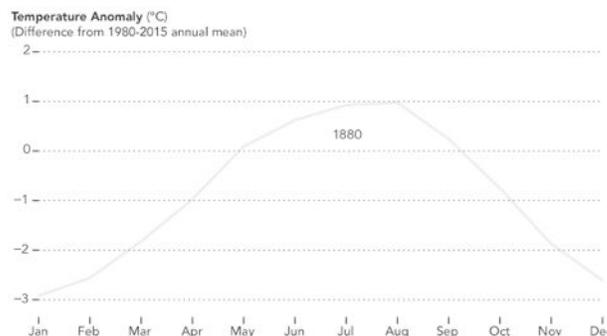
Projected 2m sea level rise.



“A rise by 2 m could displace 187 million people globally.”

Willis and Church (Science, 2012)

Temperature increase is accelerating.



The last 15 months have broken temperature records.

Rising seas are already affecting the East Coast of the US.



<http://www.nytimes.com/2016/09/04/science/flooding-of-coast-caused-by-global-warming-has-already-begun.html>

This Virginia home is being raised to avoid tidal flooding.



<http://www.nytimes.com/2016/09/04/science/flooding-of-coast-caused-by-global-warming-has-already-begun.html>

Miami is literally raising entire streets by 3 feet to avoid persistent "sunny day flooding."



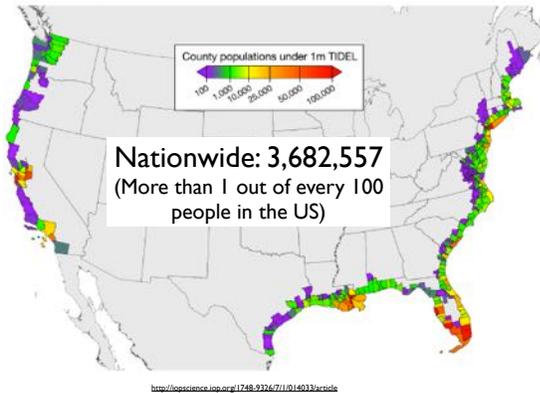
<http://www.rsmas.miami.edu/blog/2014/10/03/sea-level-rise-in-miami/>

The Pacific has thus far been



Millions of Americans could be affected by sea level rise.

Figure 2 from Benjamin H Strauss et al 2012 Environ. Res. Lett. 7 014033



<http://iopscience.iop.org/1748-9326/7/1/014033/figure2>

Heat waves are increasing.



The CDC notes more people die annually from heat than hurricanes, floods, earthquakes and tornadoes combined.

History



If we act swiftly and make changes.



If we do nothing.



Number of Days
-10 20 30 40 50 60 75 90 105 120

History



If we act swiftly and make changes.



If we do nothing.



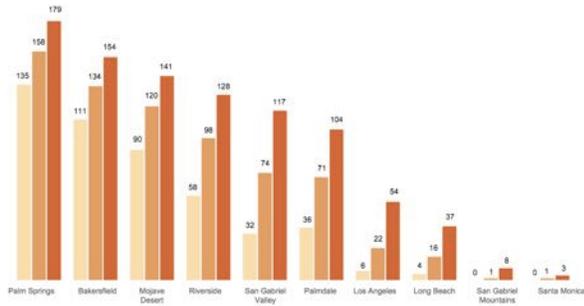
Number of Days
-10 20 30 40 50 60 75 90 105 120

The number of extreme heat days is predicted to rise dramatically if we take no action on climate change.

Downtown LA will go from 6 extreme heat days to 54.

Number of days per year with temperatures above 95°F*

- Average number of days between 1981 and 2000
- Number of days by 2050
- Number of days by 2100



*Assuming greenhouse gas emissions are not reduced <http://www.latimes.com/local/california/la-me-extreme-heat-20150514-htmstory.html>

Wildfires are becoming more common.

Los Angeles Times

Human-caused warming doubled how much of the West has burned since 1984



<http://www.latimes.com/nation/la-na-climate-change-fire-20161010-snap-story.html>

Droughts are becoming more common.

U.S. News & WORLD REPORT

US Southwest faces threat of megadroughts with rising temps



“researchers calculated there’s between a 70 percent and 90 percent chance the Southwest will experience a megadrought [oppressive dry spells lasting at least 20 years] later this century [if we take no action].”

http://www.usnews.com/news/news/articles/2016-10-05/us-southwest-faces-threat-of-megadroughts-with-rising-temps?src=usn_fb

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If countries follow through with the Paris climate agreement to reduce emissions from the burning of coal, natural gas and oil to limit global temperature rise to well below 2 degrees Celsius (3.6 degrees Fahrenheit), then the risks are cut nearly in half

http://www.usnews.com/news/news/articles/2016-10-05/us-southwest-faces-threat-of-megadroughts-with-rising-temps?src=usn_fb



With drought, heat, and extreme weather, our food and water supplies will be increasingly threatened.

At the same time, we’ll have an influx of climate refugees displaced by sea level rise, wildfires, drought, etc.



It will become increasingly difficult to keep peace.



Every year we wait to take action makes our challenge exponentially more difficult.

To stay below the “safe limit” of 2°C,



If we start in 2016: ↓ 6% per year

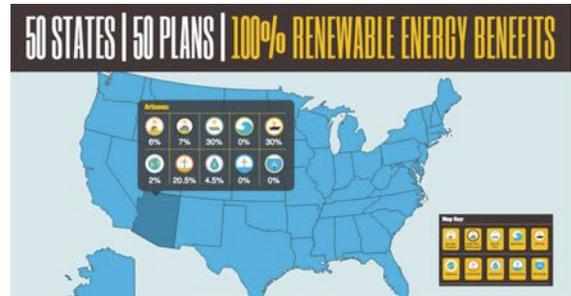
If we wait until 2020: ↓ 10% per year

- Peter Kalmus, JPL climate scientist



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We already have all the technology we need to stop using fossil fuels.



<http://thesolutionsproject.org>

Youth around the country have sued the government for failure to protect their future. They are winning first steps.

Politicasusa

21 Youth Win Historic Climate Ruling Against Fossil Fuel and the Government

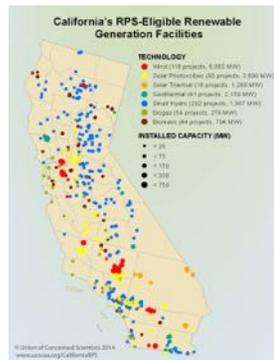


195 countries agreed in Paris Dec 2015 to limit warming to "well below two degrees."



California this year passed massive climate legislation.

This year: SB 32: California greenhouse gas reduction target of **40 percent below 1990 levels by 2030.**



The clean energy revolution will create a staggering number of jobs for the children in school today.



There is so much low-hanging fruit.

Energy Efficiency

a.k.a ... how to save money and your future at the same time!



The solutions to climate change come with many “extra” benefits.



Never doubt that a small group of thoughtful, committed people can change the world. Indeed, it is the only thing that ever has.

MARGARET MEAD