



Earth Day

1970 – 2070

Where we were ...

Where we are ...

And where we're going ...





Where we
were...



Svante Arrhenius 1859 - 1927

Guy Callendar 1898 - 1964



Charles Keeling 1928 - 2005



The 125 Year Story of Global Warming Research

In 1896, Noble Prize-winning Swedish scientist Svante Arrhenius described how CO₂ from burning fossil fuels could lead to a global warming—creating what he called a “hotbed effect.”

In 1938, Guy Callendar, a British Engineer, compiled measurements of temperatures from the 19th century on and correlated these measurements with old measurements of atmospheric CO₂ concentrations. Callendar’s calculations suggested that a doubling of CO₂ in Earth’s atmosphere could warm Earth by 2 degrees C (3.6 degrees F) – very close to today’s calculations.

In 1953, Charles David Keeling a postgraduate geochemist at Cal Tech embarked on a study to compare the relative abundances of carbon dioxide in water and air. Keeling soon determined that the level of atmospheric CO₂ was approximately 310 parts per million (ppm).

Working with Roger Revelle at Scripps Institution of Oceanography, along with Henry Wexler of the U.S. Weather Bureau, Keeling established in 1959 that the year-on-year, amount of carbon dioxide in the atmosphere was increasing due to burning fossil fuels.

By 1967, a team led by Syukuro Manabe of the National Oceanic and Atmospheric Administration (NOAA) had devised the first comprehensive model of the response of climate to an increase in atmospheric CO₂ extrapolated from the Keeling Curve. It predicted that a doubling of carbon dioxide in the atmosphere would cause an increase in global temperature of between 3 to 4 degrees Fahrenheit, with severe consequences.

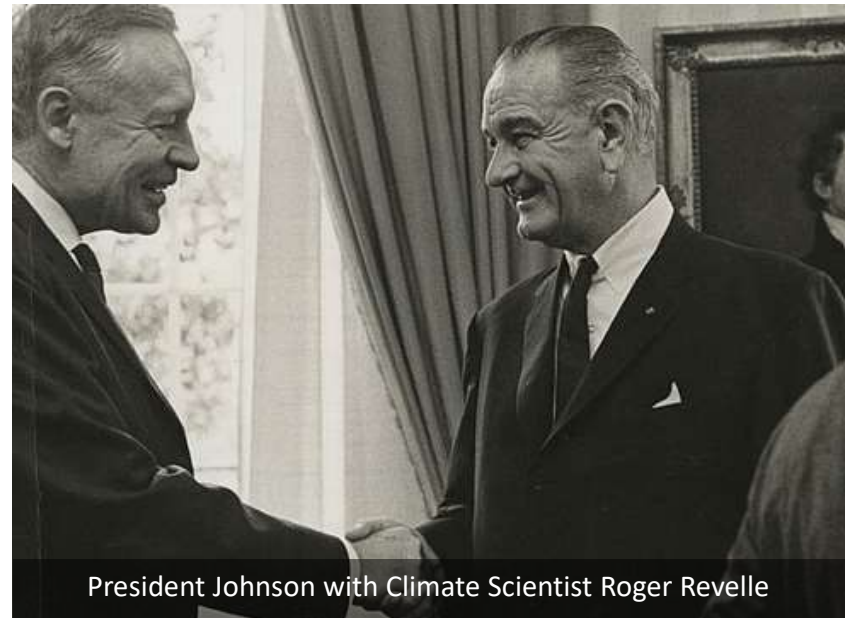
A 1958
Science Film
produced by
Bell Labs



The film portrayed a warming earth melting ice caps

President Johnson's February 8, 1965 Speech Warning Congress on the Dangers of CO₂

"This generation has altered the composition of the atmosphere on a global scale througha steady increase in carbon dioxide from the burning of fossil fuels... Pollution destroys beauty and menaces health.The longer we wait to act, the greater the dangers and the larger the problem."

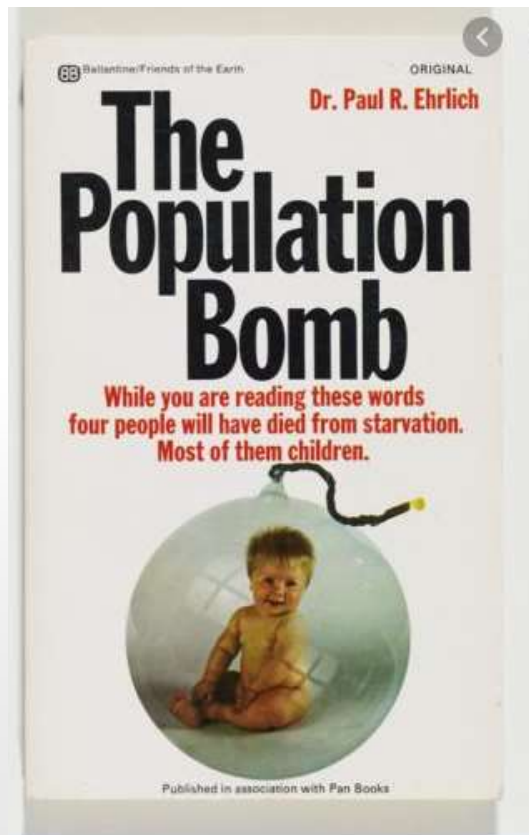


President Johnson with Climate Scientist Roger Revelle

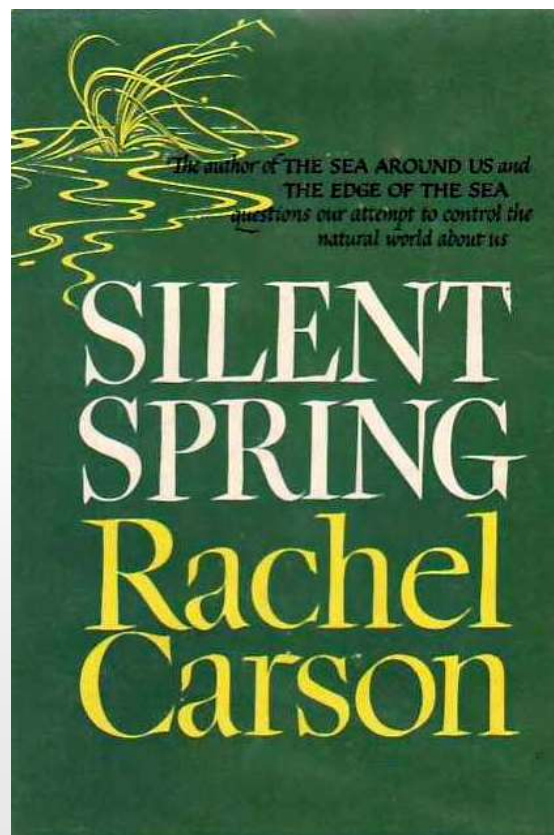
1968 Report to the American Petroleum Institute

In 1968, in a report commissioned by the American Petroleum Institute (API), Elmer Robinson — a meteorologist who led environmental research at the Stanford Research Institute (SRI) warned industry leaders at (API) that rising carbon dioxide concentrations in the atmosphere "may be the cause of serious world-wide environmental changes.... It could affect sea-level rise, glacial melt, lead to potentially severe environmental damage worldwide."






Published in 1968



Published 1962

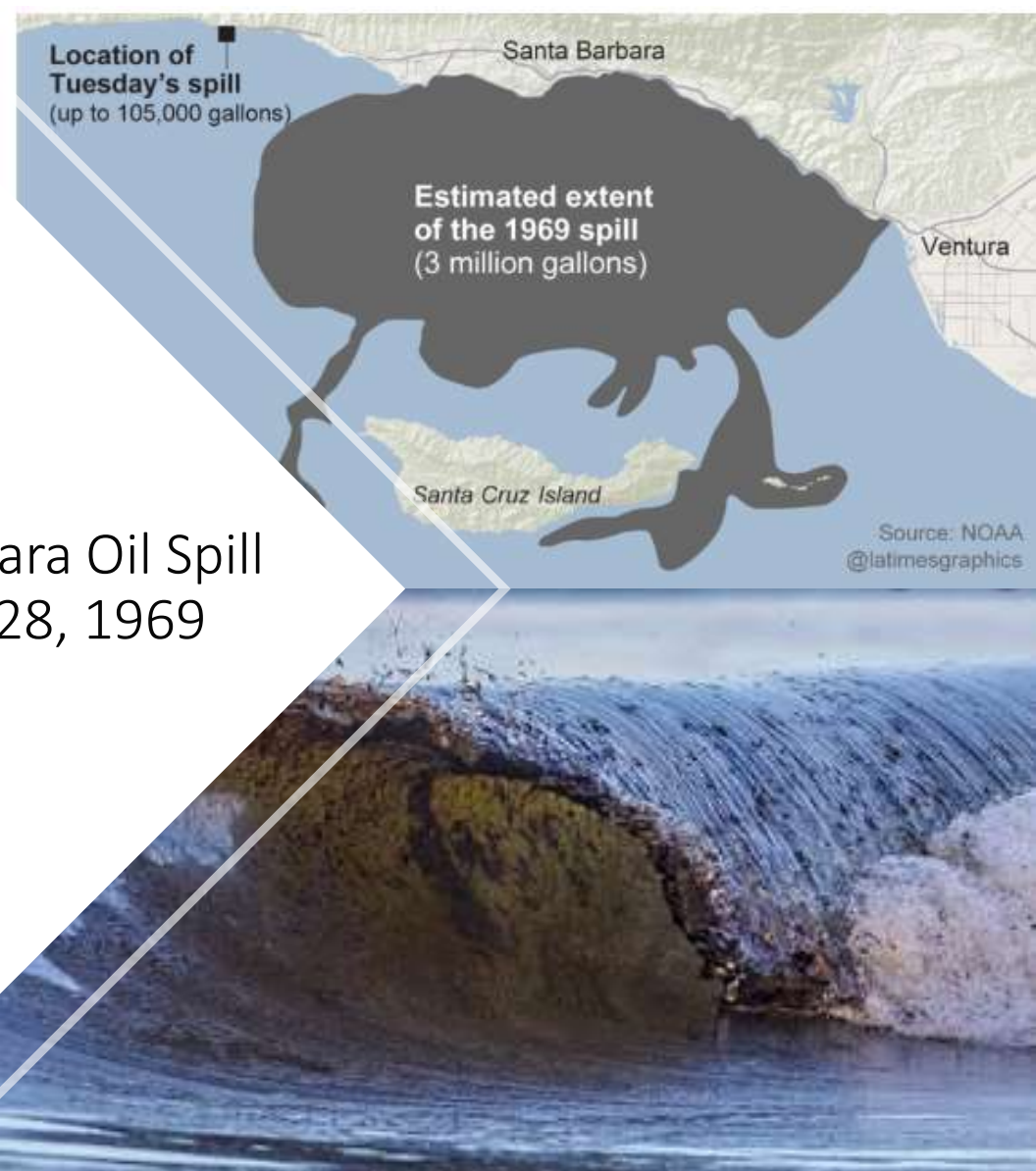


Science Magazine 1968



1968, Christmas eve —
Apollo 8 astronauts
take first photos of
“Earthrise.”





Santa Barbara Oil Spill
January 28, 1969

Cuyahoga River Fire,
Cleveland, Ohio,
June 22, 1969





Nationwide University Teach-Ins to End the War in Vietnam – October 15, 1969

Senator Nelson Announces Environmental Teach-In for Spring 1970

In 1969, Senator Nelson of Wisconsin, one of the Senate's leading environmental leaders, had just toured the oil spill devastation on the coast of Santa Barbara and was flying to San Francisco when he read an article about recent popular teach-ins held on college campuses. The format struck him as a promising way to communicate this growing public concern to elected officials in Washington D.C. and state government. He believed that:

"If we could tap into the environmental concerns of the general public and infuse the student anti-war energy into the environmental cause, we could generate a demonstration that would force the issue onto the national political agenda."

Senator Nelson [announced the Earth Day concept](#) at a conference in Seattle in on September 8, 1969 and invited the entire nation to get involved.



THE GAYLORD NELSON NEWSLETTER
Washington, D.C.
November 1969

Environmental Teach-In Planned National Effort Set For Spring

The development of comprehensive plans to kick off a national teach-in on the Crisis of the Environment to take place this spring on college campuses across the country will be announced this month by Sen. Gaylord Nelson.

The Wisconsin senator said he has been traveling around the country talking about his teach-in idea and seeking support for the proposal.

By the end of the month, Nelson expects to have a national headquarters on the teach-in set up in Washington with a staff that will be contacting students all across the country.

The teach-in plans call for a day, probably in April, when normal campus activities will be set aside for the university and the local community to get together and discuss the mutually shared environmental problems.



Apostle Islands Legislation

The Nelson bill to establish Apostle Islands as a part of the national park system passed the Senate in June, and the Senator is hopeful the House will authorize the necessary money to make the proposal a reality by the end of next year.



San Jose State College “Survival Faire”

February, 1970

Students bought and buried a new Ford in the Center of the campus to protest high smog levels.

The Faire help create one of the nation's first environmental studies department.



The

NEW YORK, THURSDAY, APRIL 22, 1970
Millions Join Earth Day Observances Across



Earth Day

April 22, 1970

1 in 10 Americans participated



The Today Show ran an entire week of programming for the first Earth Day

The show's host, Hugh Downs, opened the week as follows:

"Our Mother Earth is rotting with the residue of our good life. Our oceans are dying and our air is poisoned....do we go on demanding more and more...until we suffocate or die of plaque or famine."



Where we are
Post 1970

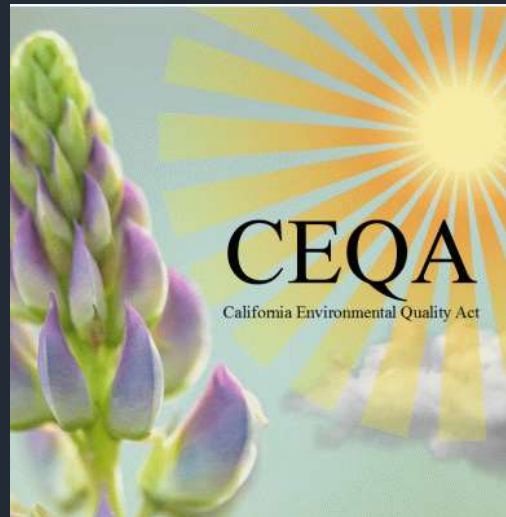
EPA was
formed

Seven months
after the 1970
Earth Day



The California Environmental Quality Act

signed into law 1970 by
Governor Ronald Reagan



Man selling fresh clean desert air for 50 cents a balloon full in Los Angeles, Oct. 22, 1954

In the 1970's air in Los Angeles hit unhealthy levels of pollution more than 200 days a year. Today it has been reduced to 80 days .

The center focuses
on emerging
technologies and
user behavior
studies for plug
load devices.



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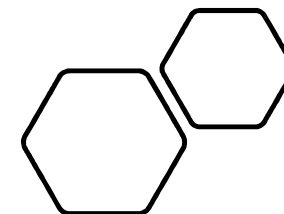
U.S. Congress passed the legislation in 1973



U.S. Congress passed the legislation in 1972



- 1972** Chinese representatives attended the first United Nations Conference on Humans and the Environment
- 1983** China's national government made environmental protection state policy
- 1998** China formed the State Environmental Protection Agency
- 2018** The EPA was reorganized to become the Ministry of Ecology & Environment



Earth Day 2020

Over 1 billion
people participate
in Earth Day
Activities In 193
countries

"I don't want you to be hopeful, I want you to panic. I want you to feel the fear I feel every day. And then I want you to act. I want you to act as if the house is on fire. Because it is." Greta Thunberg UN Speech

CLIMATE ACTION 2020

19 YOUTH CLIMATE ACTIVISTS YOU SHOULD BE FOLLOWING ON SOCIAL MEDIA





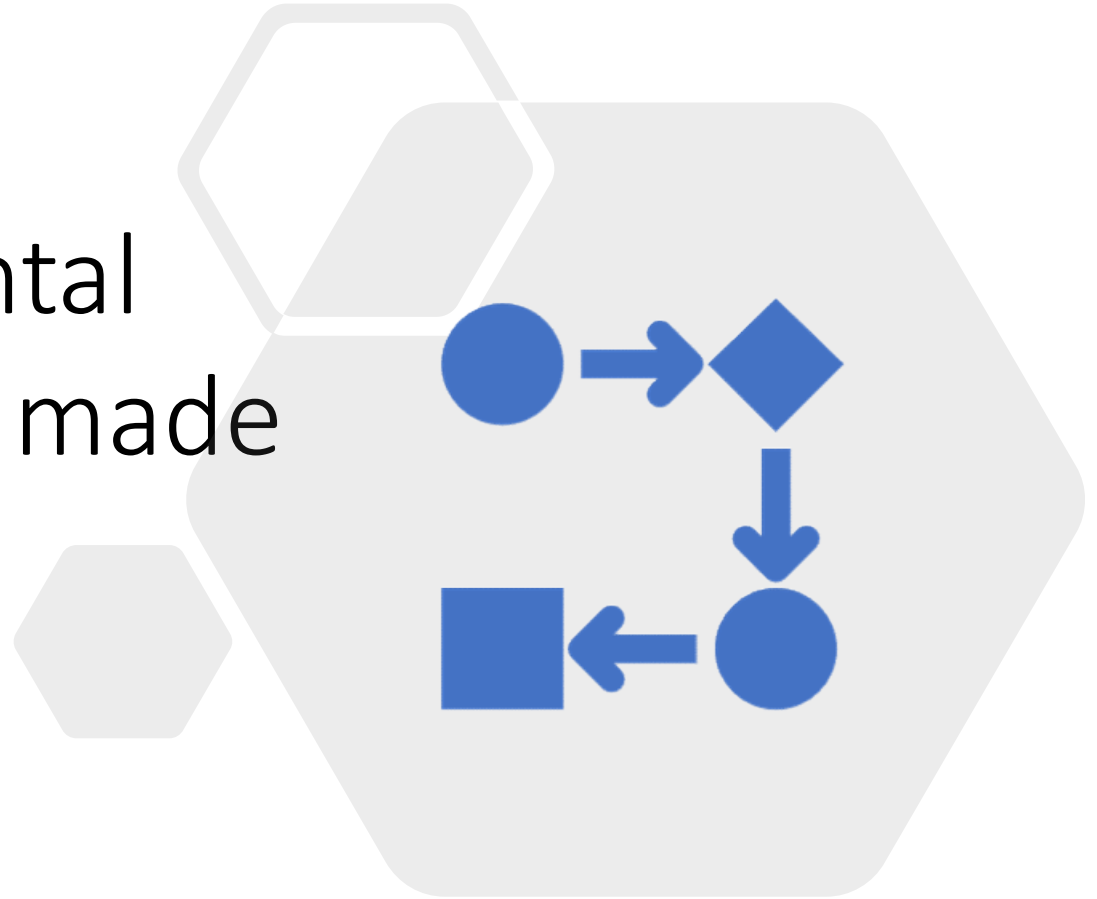
1994 China's government approved the creation of Non-Governmental Organizations (NGO's) allowing many public environmental organizations to form

2004 100,000 Chinese college students took part in Earth Day activities

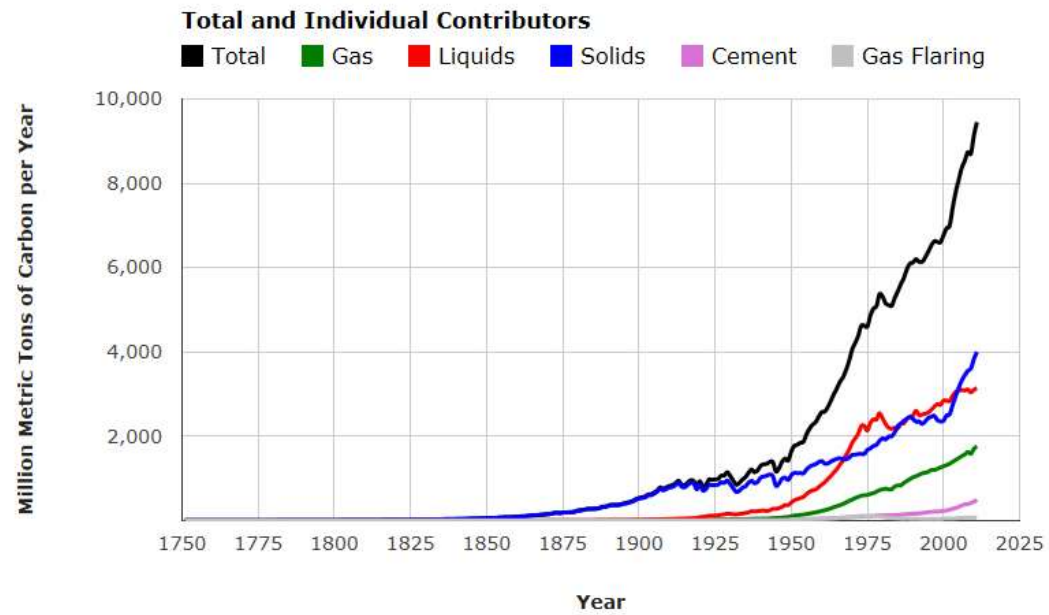
2006 NGO's produced their first annual report on China's Environment

2020 Chinese youth take an active role in supporting environmental issues

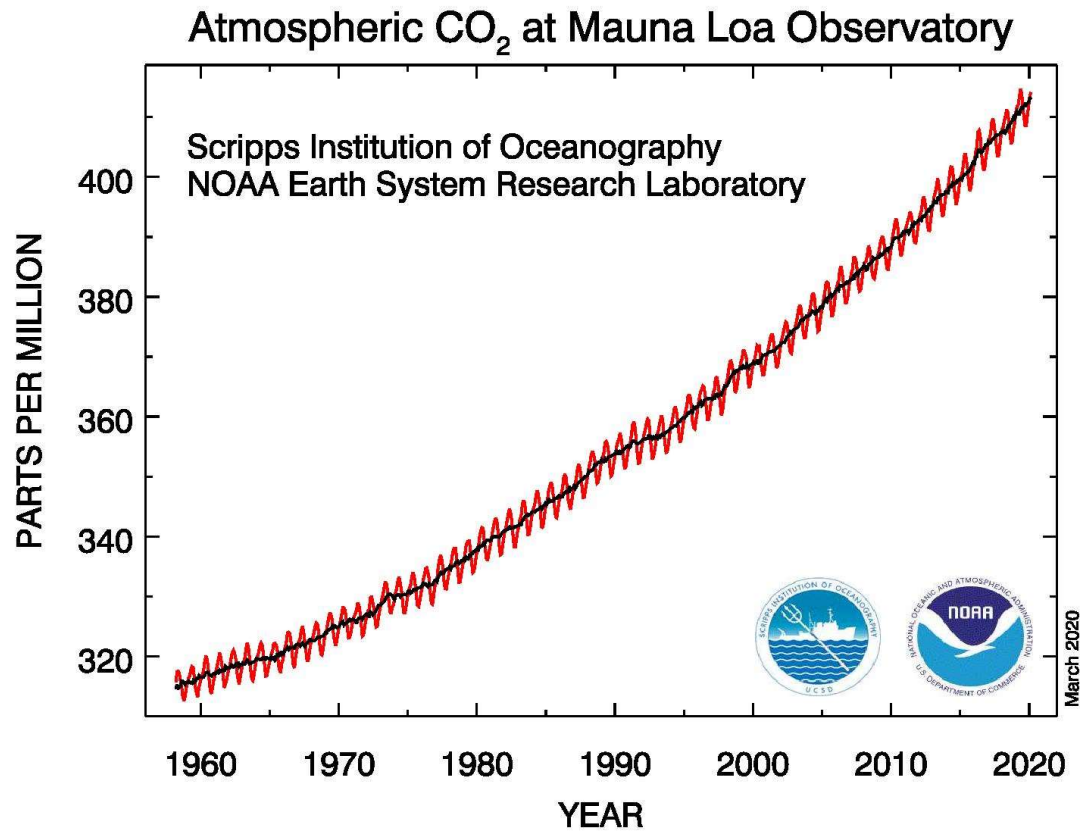
What Environmental
Progress have we made
Since 1970



Changes in
Global CO₂
Emissions
since 1970 –
increased 300%

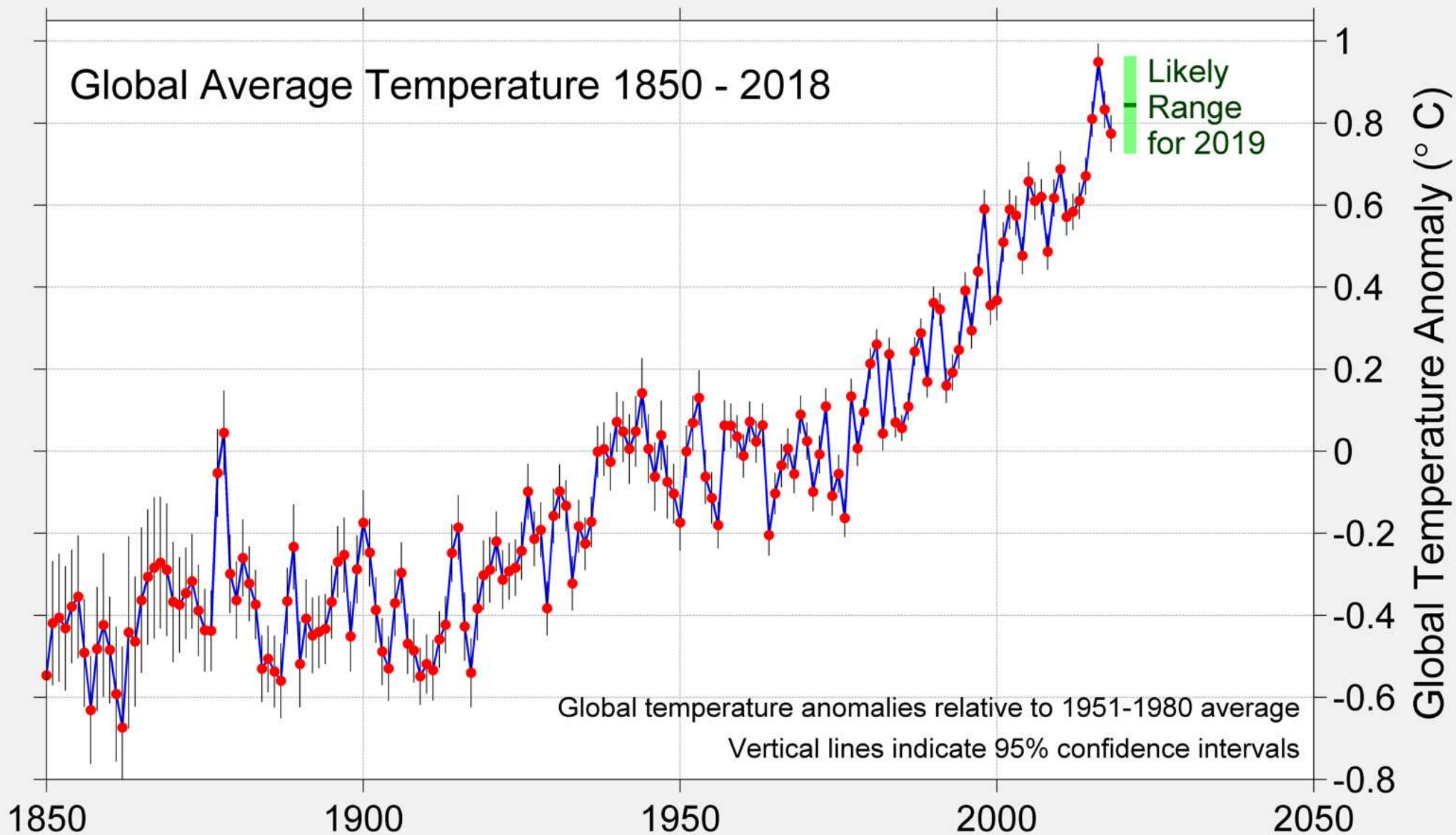


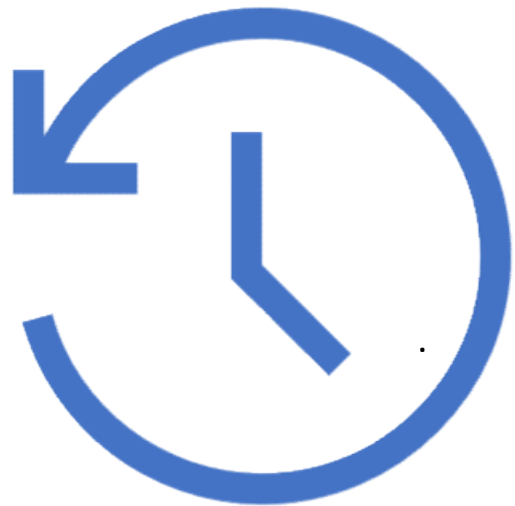
Source: Boden, T.A., G. Marland, and R. J. Andres. 2015. Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.



Atmospheric CO₂ has increased 30% since 1970. By 2016, the annual low was above 400 ppm for the first time in several million years.

Global Average Temperature 1850 - 2018





What's driving these changes

GDP per capita

GDP per capita adjusted for price changes over time (inflation) and price differences between countries – it is measured in international-\$ in 2011 prices.

Our World
in Data

LINEAR



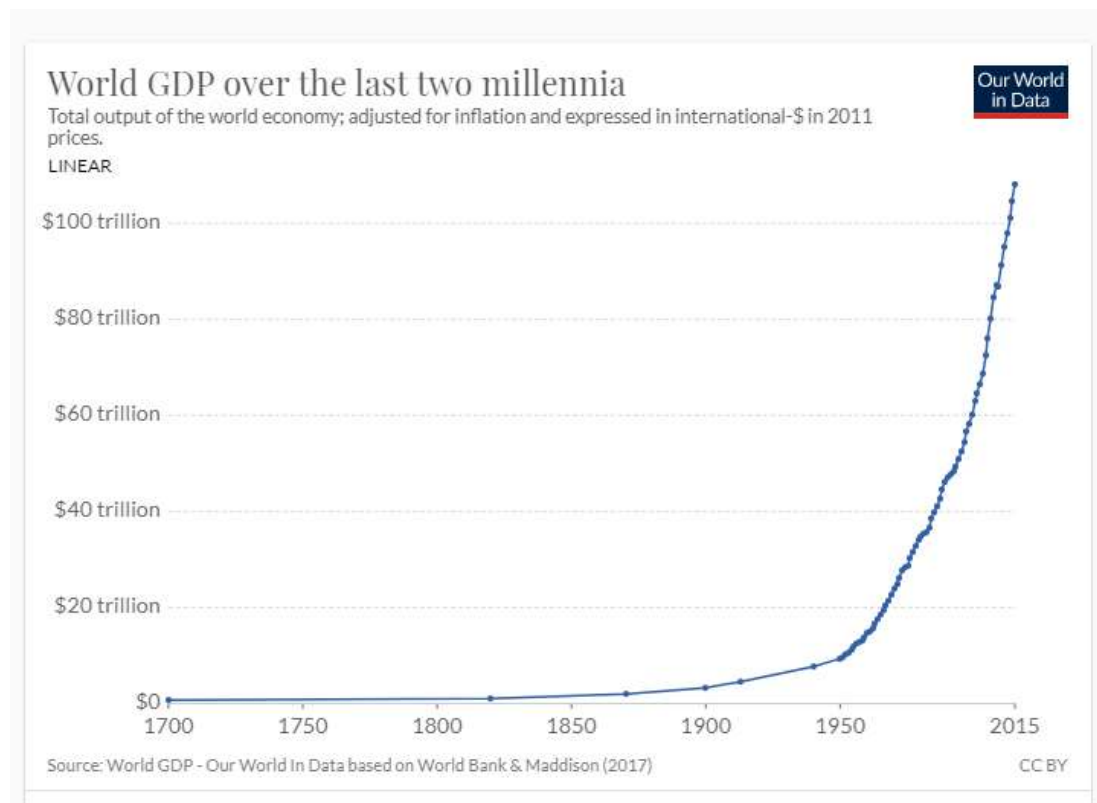
Source: Maddison Project Database (2018)

Note: These series are adjusted for price differences between countries using multiple benchmark years, and are therefore suitable for cross-country comparisons of income levels at different points in time.

CC BY

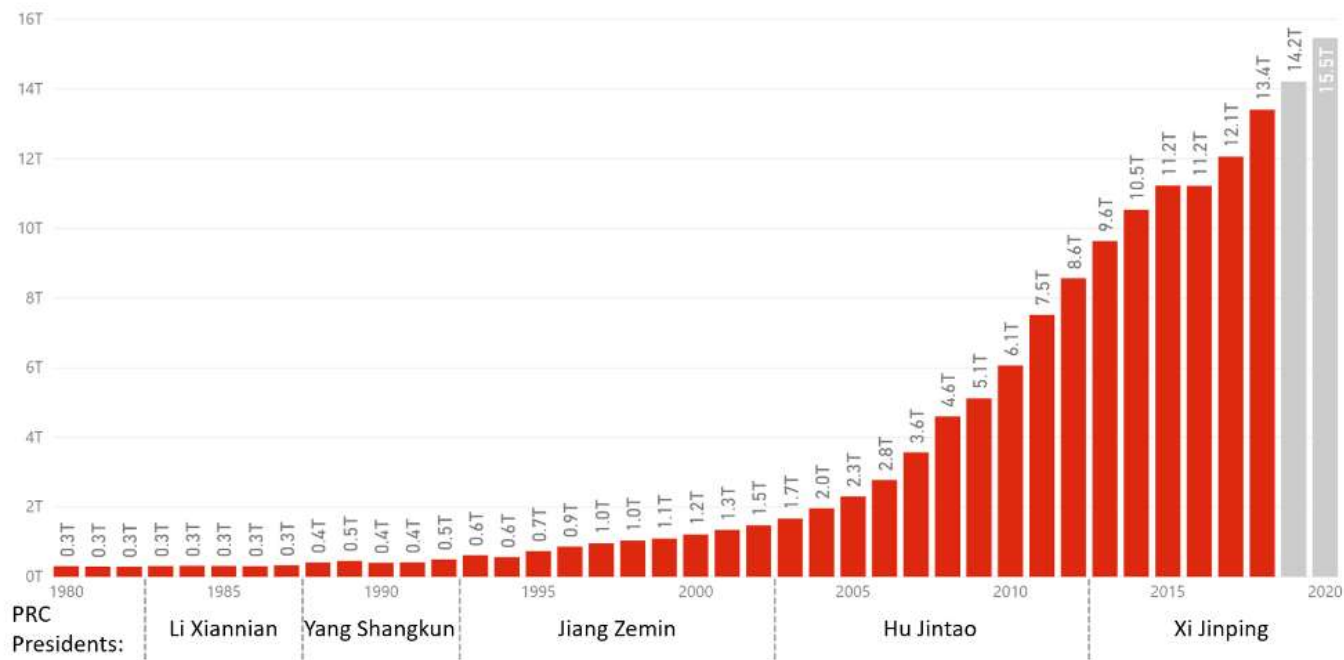
United States
GDP Per Capita
Increased
250% Since
Earth Day 1970

Global GDP
has grown
500% since
Earth Day
1970



China GDP

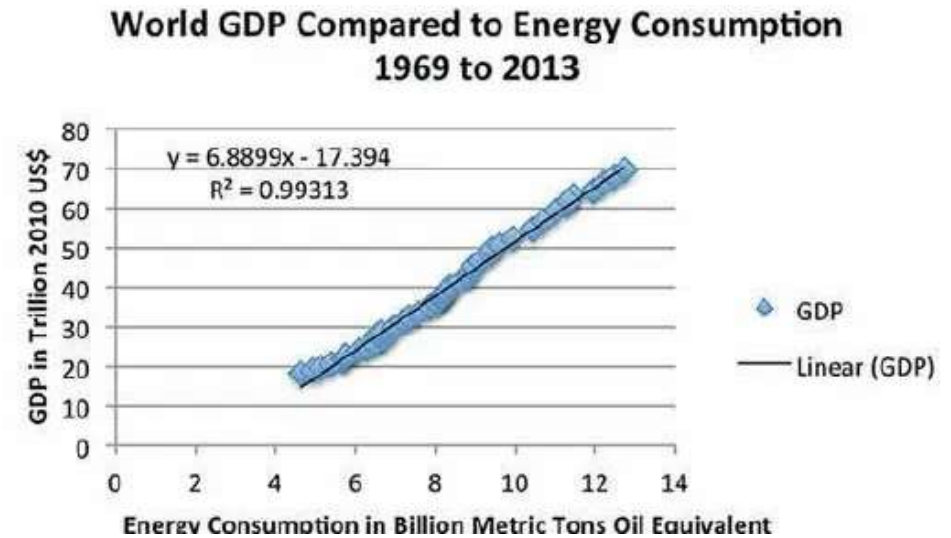
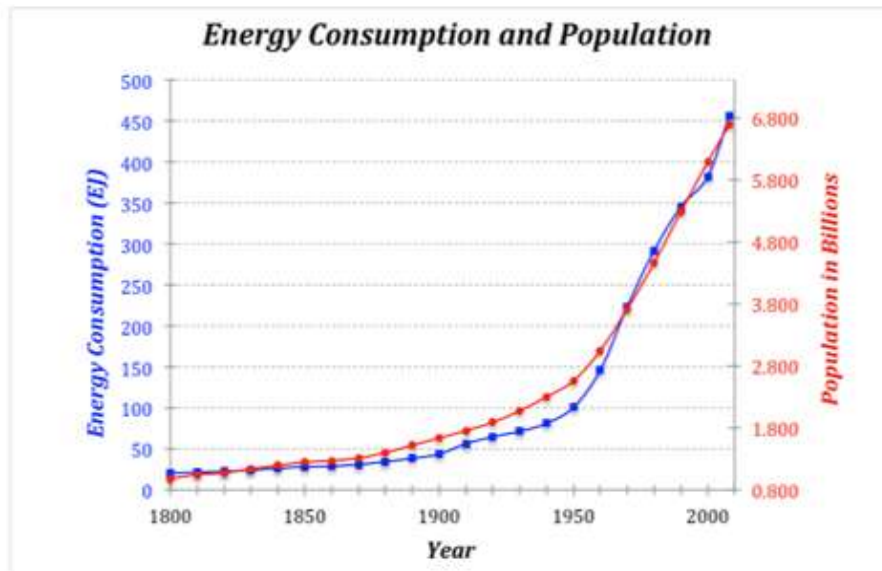
GDP in current prices (trillions of US dollars)



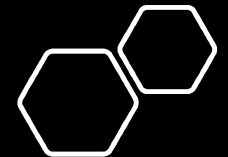
Data Source: IMF World Economic Outlook, April 2019

Data Analysis by: MGM Research

China's GDP
has grown
5,000 % since
Earth Day
1970

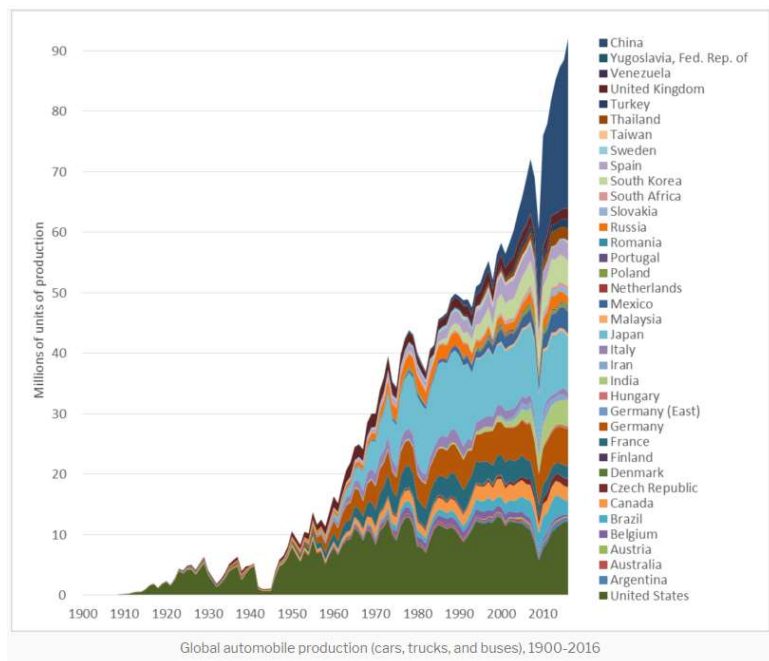


GDP represents the direct byproduct of energy consumption and population growth

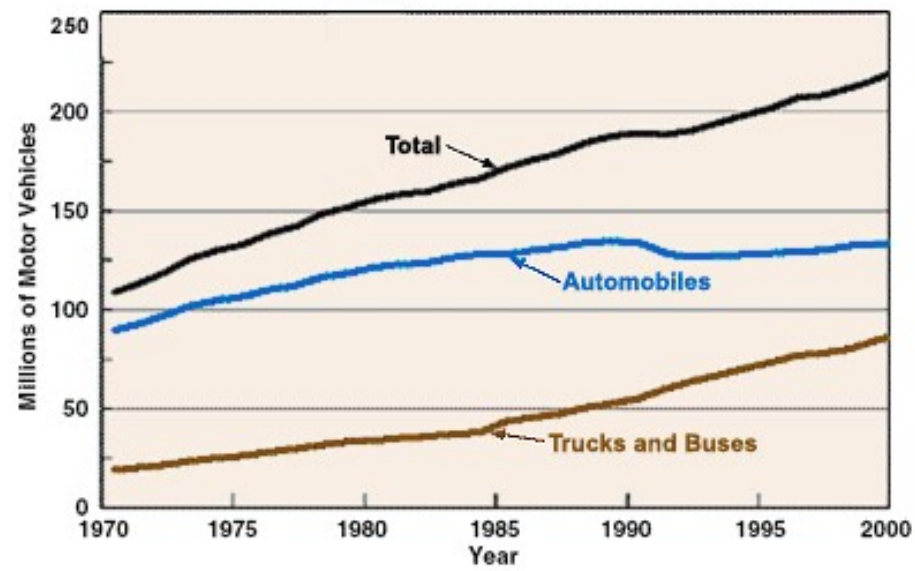




Until now, GDP has been the byproduct of
converting energy (primarily stored sunshine)
into applied energy (goods)



Growth in global vehicle production has increased 300% since 1970



Growth in U.S. vehicle licenses since 1970 has increased 200%

Air traffic will double in the next 15 years

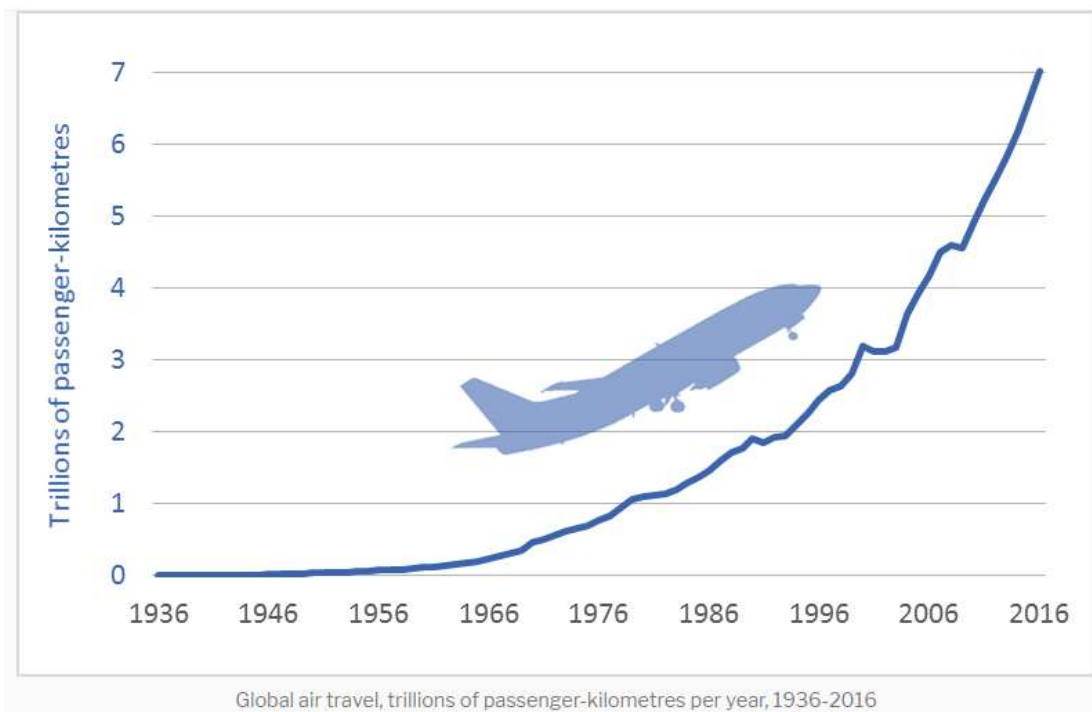


Global Air Traffic doubles every 15 years

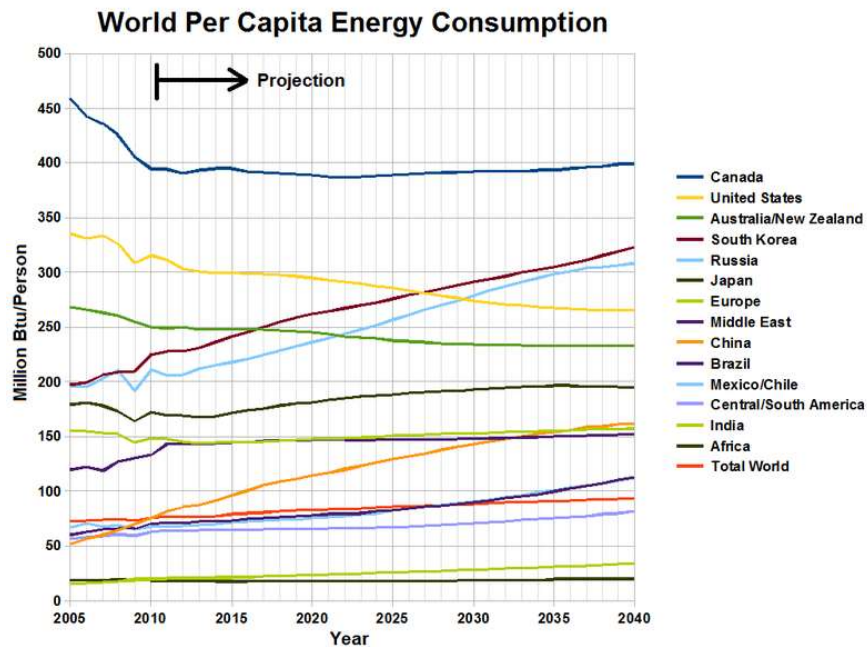


U.S. Passenger Travel Since 1970 up 500%

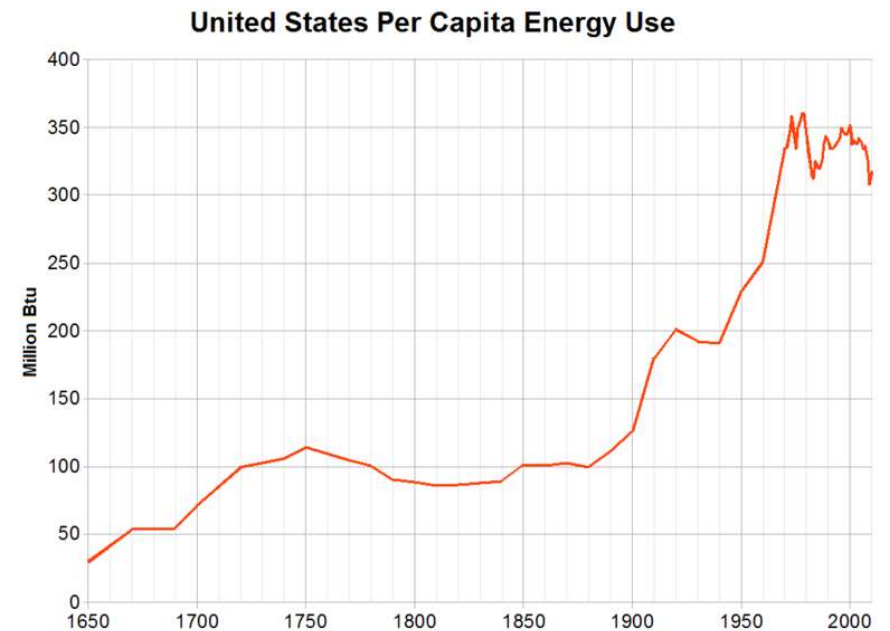
Global air travel has increased 1,400% since 1970



Global Per Capita Energy Consumption is forecast to double 2020-2070



U.S. Per Capita Energy Consumption Down 10% Since 1970 –
Total U.S. demand forecast to increase by 15% by 2070

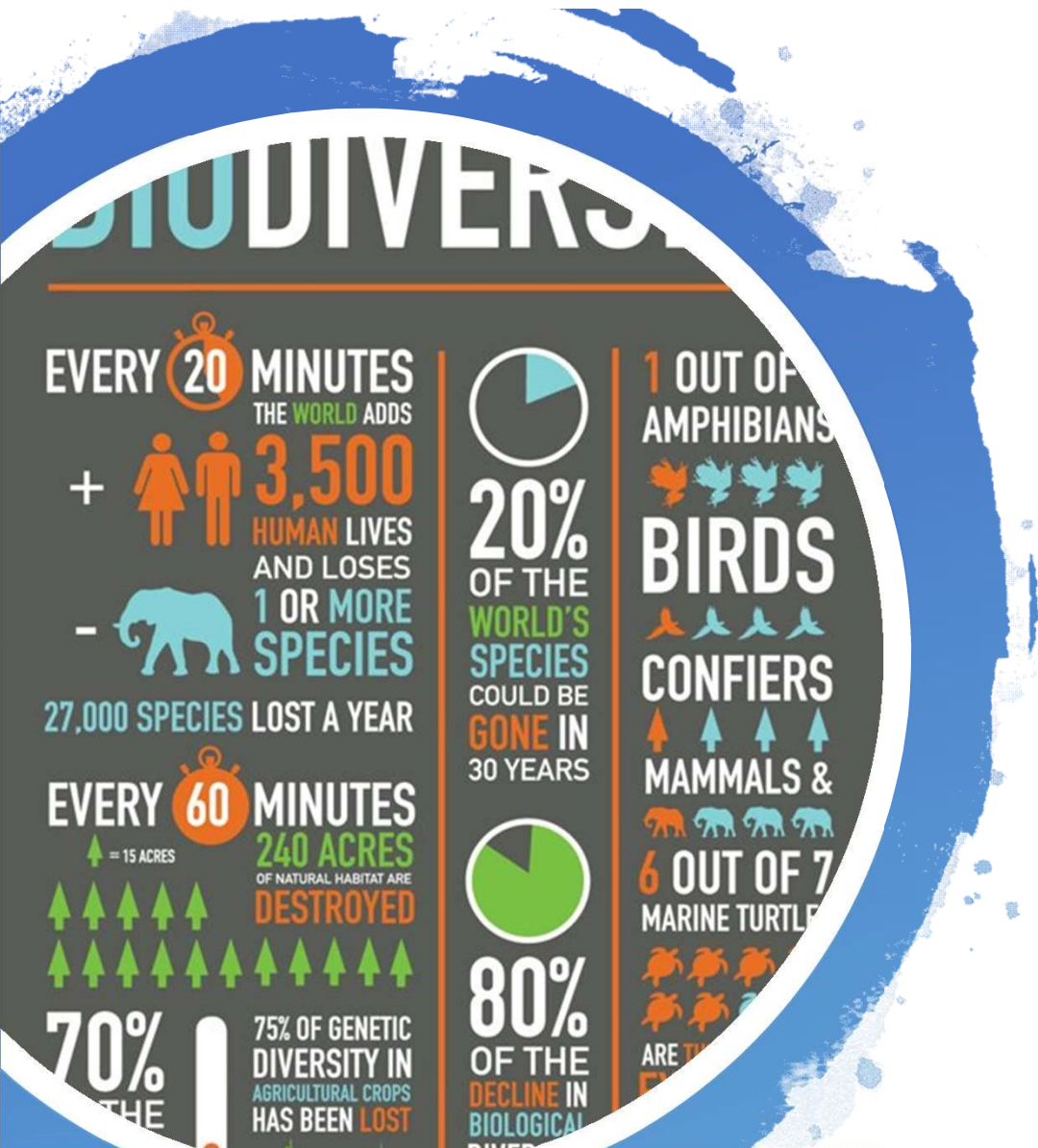


“Science also tells us what needs to be done and how. The “Report of the Intergovernmental Panel on Climate Change (IPCC) on the Impacts of Global Warming of 1.50C above pre-Industrial Levels” demonstrates that **we must limit global warming to 1.50C by the end of this century to avoid irreversible and catastrophic impacts.**

This means that carbon dioxide (CO2) emissions need to decline by about 45 percent by 2030 and reach net zero in 2050. While the IPCC says that this goal is within reach, ***to achieve it would require urgent and unprecedented social and economic transformation.***”

UN Secretary General Antonio Guterres





Humanity has wiped out 60% of mammals, birds, fish and reptiles since 1970

WWF Report 2018

An aerial photograph of a tropical forest. A wide, cleared path or road, appearing as a light brown line, cuts diagonally across the lush green canopy. The forest is dense and vibrant green, contrasting sharply with the cleared area.

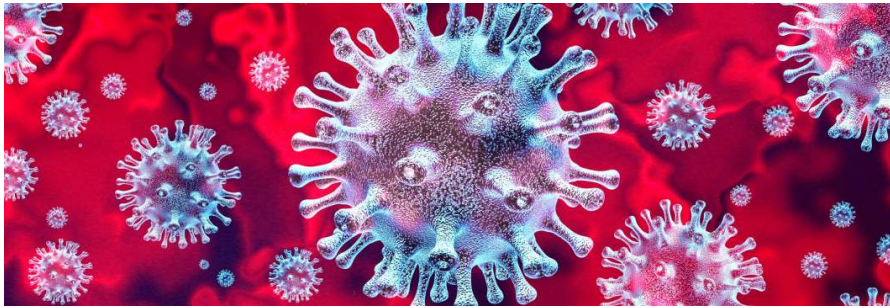
Deforestation alone
has contributed
40% of global
warming since the
industrial revolution

Studies by Cornell University
scientists calculate that the current
rate of tropical deforestation will
alone raise global temperatures 2.7 F
by 2100

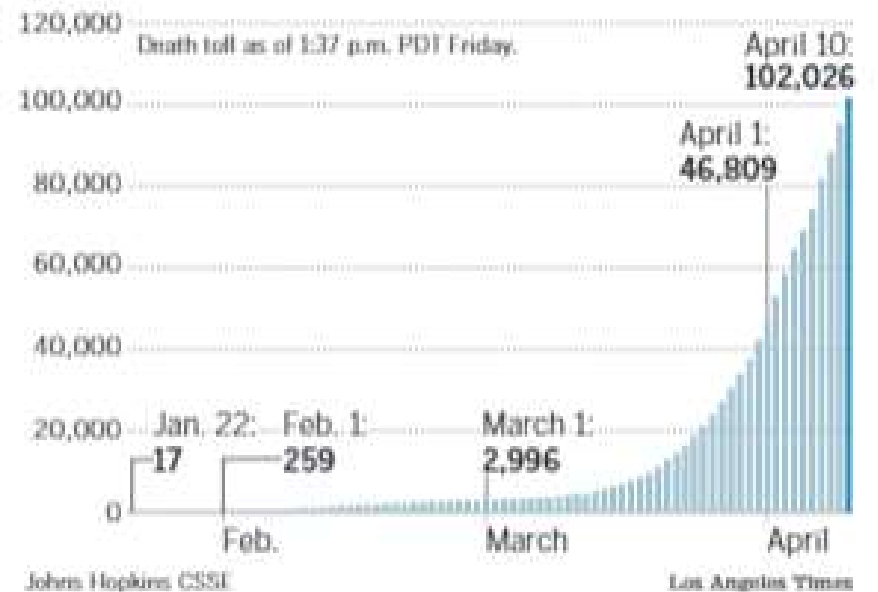


The United Nations 2019 (IPCC) *Climate Change and Land Report* finds that it will be impossible to keep global temperatures at safe levels unless there is also a transformation in the way the world produces food and manages land.

802,000 Square kilometers of Amazon forest lost to food production since 1970



Coronavirus deaths in the world





COVID-19 is a symptom of a growing global problem - people coming into closer, unnatural contact with wildlife.

COVID-19 jumped from wild animals being exploited for commercial use – most likely from illegal trafficking.

Pandemics will become increasingly common – SARS, MERS, H1N1 - if we continue to ignore the links between infectious diseases and the destruction of the natural world.

Where are these various trends leading us:

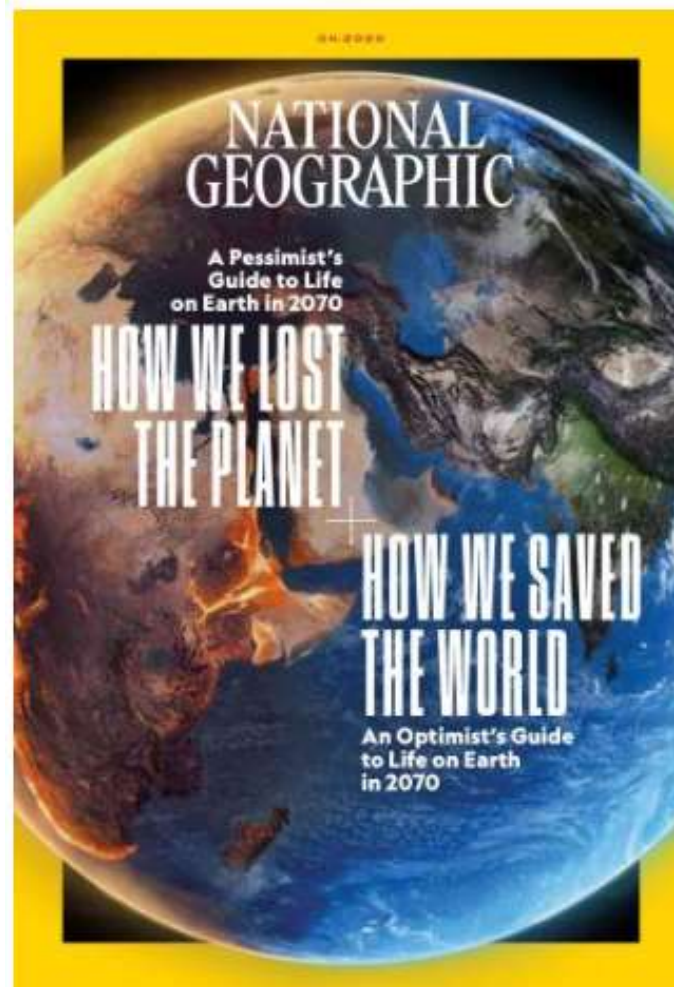
The Sustainability Center at the University of Massachusetts issued a report two months ago of the findings of over 200 leading environmental scientists:

Overlapping environmental crises “in combination have the potential to impact and amplify one another in ways that might cascade to create a global systemic collapse.”






Life on Earth 2070



April 2020 Edition



All we need to do to save the
planet's climate and natural
world is to simply stop doing
what we're currently doing!



What Should We Do?

Thought Experiments on how much technology
(increased energy efficiencies) can reduce CO₂ Emissions

How much can CO₂ emissions be reduced if we convert 2/3 of global energy production to renewables by 2070?

Global energy needs are forecast to double by 2070.

Annual net global CO₂ reduction accounting for embedded CO₂ in renewable facilities & equipment.

-10%



How much can CO₂ emissions be reduced by converting 2/3 of the global vehicle fleet to electric by 2070?

The global vehicle fleet is expected to increase 500% by 2070.

Electric cars with 2/3 renewable energy sources and accounting for imbedded lifecycle CO₂ reduces CO₂ emissions 75% per comparable gas driven vehicle.

+250% in Total CO₂ From Vehicles





How much can CO₂ emissions be reduced if airline travel becomes 100% more efficient by 2070 ?

Current air travel projections are for an increase of 400% by 2070

+ 200%

How much global CO2 emissions can be eliminated if we reduce the amount produced by global food production 50% by 2070?

Global food production creates 25% of total CO2 emissions

The world's population is expected to increase 20% by 2070

-15%



The driver in greenhouse emissions is global GDP growth – increased applications of energy (consumption) across a growing population.

As the world's population will not decrease before 2070, and technological efficiency can only produce incremental impact, the only other factor in the equation that can significantly reduce CO2 emissions is restructuring consumption.





Achieving the Good Life - 2070

Mankind is at a fork in the road

We can continue as we are – tying GDP growth to a high energy and material consumption economy

OR

We can tie our GDP growth to a new range of values and experiences



Looking Back From 2070 – What We Did Right In 2020 To Save The World

We broke free from our destructive economic equations:

GDP Value = CO2 discarded into the atmosphere & oceans

GDP Value = Amount of Stored Energy Consumed

GDP Value = Resource Extraction Levels

We'll still live in a hotter world



Our World In 2070 –
What We Did Right In 2020
To Save It

Global GDP increased its growth rate, but contributing sectors have changed. We generate a significant portion of global GDP maintaining environments under stress and rebuilding nature's resilience



We shifted global budget priorities to creating global resilience, increasing research, prioritizing lifelong education, health & life extension





More Experiences

We shifted our focus to meeting our needs more through richer experiences than through increasing material consumption



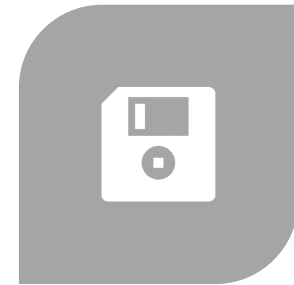
We became More Connected

We utilized the Digital Revolution
(6G, AI, etal) to seek more satisfaction
in digital spaces, self-exploration,
social interactions, creative pursuits



OUR WORLD IN 2070

—



TO SAVE IT

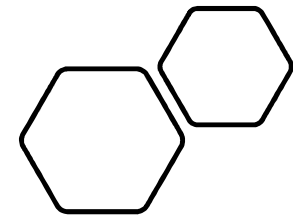


More Teamwork

The global cloud networks give birth to seeing the world as a connected neighborhood, giving rise to entirely new forms of understanding and cooperation



More Nature



Global food production became much less soil based. Half of the land was returned to a more wild state.

We changed our diets to be more environmentally friendly (and healthier).

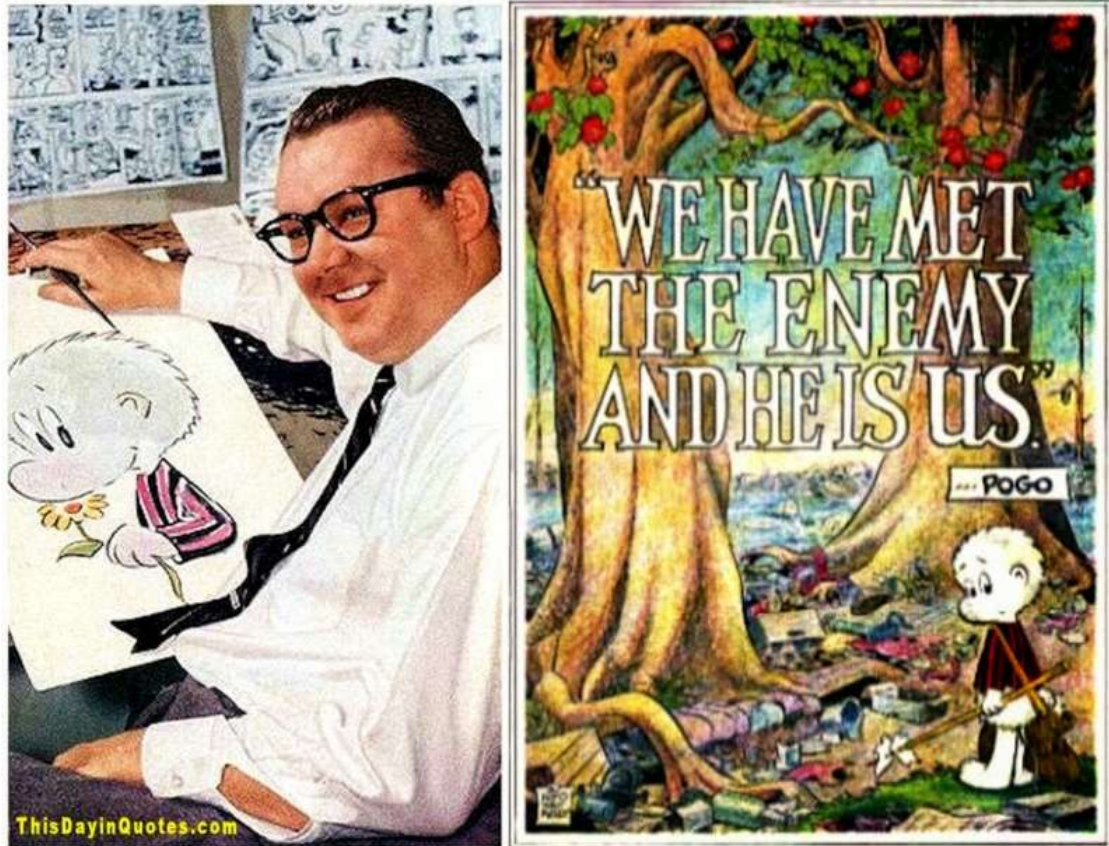


More Equitable

Our world is automated making access to everything more equitable because life now provides more with less resources

Earth Day
Poster 1970

“We have met the enemy and he is us” Pogo



THANK
YOU