

The Environment: Saving Ourselves from Ourselves



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UNC | GILLINGS SCHOOL OF
GLOBAL PUBLIC HEALTH



100 years
Environmental solutions
for a changing world

- Setting the stage
 - A brief walk through time
- Globalization: (+/-)s
 - Energy
- Clearing the air
- Climate change
 - An industrial evolution
- Preserving the future?

photo

There are known knowns; there are things we know that we know.

There are known unknowns; that is to say, there are things that we now know we don't know.

But there are also unknown unknowns – there are things we do not know we don't know.

-Donald Rumsfeld

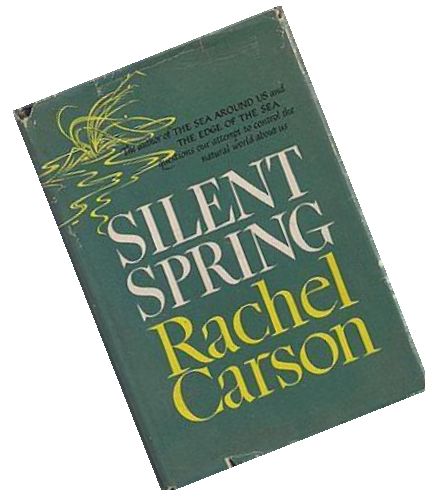




But man is a part of nature, and his war against nature is inevitably a war against himself.



Rachel Carson
1907 - 1964



Published 1962

Systems within Systems



The Allegory of the Yellowstone Wolves



George Monbiot – TED 2013

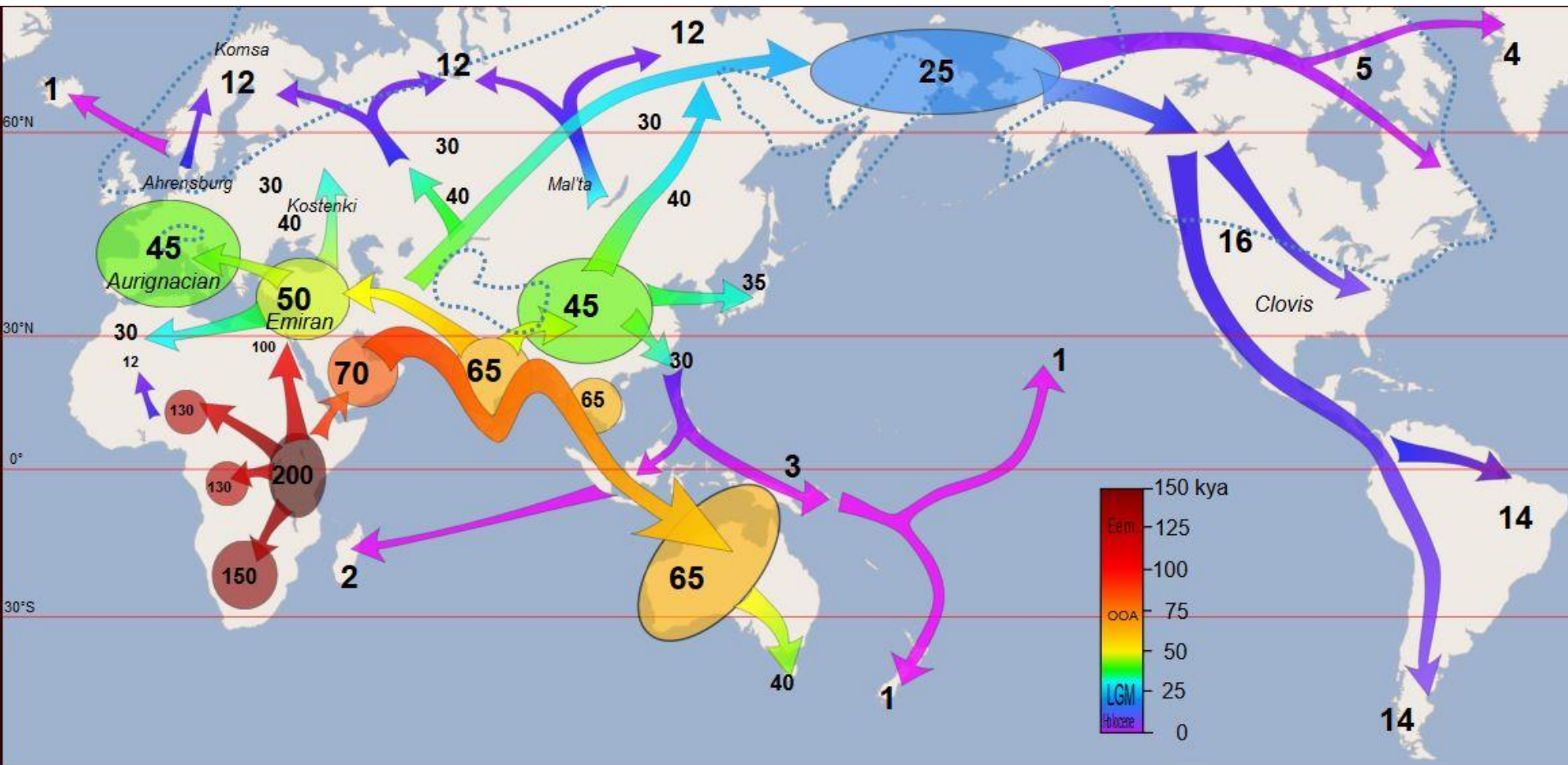
Globalization – Humankind's Manifest Destiny

Genesis 1:28 - King James Bible

On the 6th Day...

...God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.











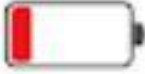









Early Migrations of Anatomically Modern Humans



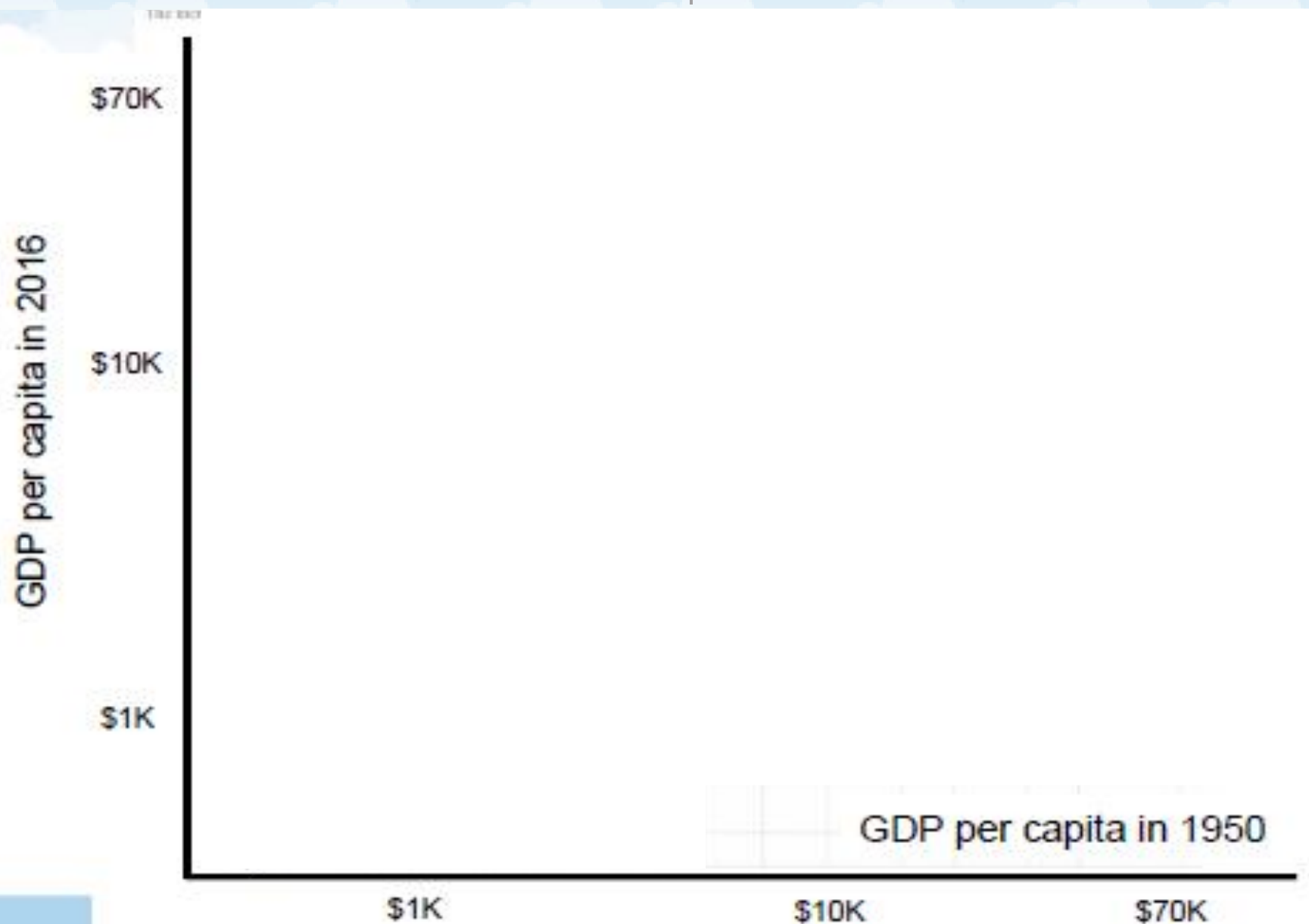
Wiki user:Dbachmann [CC BY-SA (<https://creativecommons.org/licenses/by-sa/4.0>)]

The Evolution of Globalization

In 100 BC the Silk Road kicked-off a 1350 year legacy of taking silk and spices from China to the *well-to-do* in Europe.

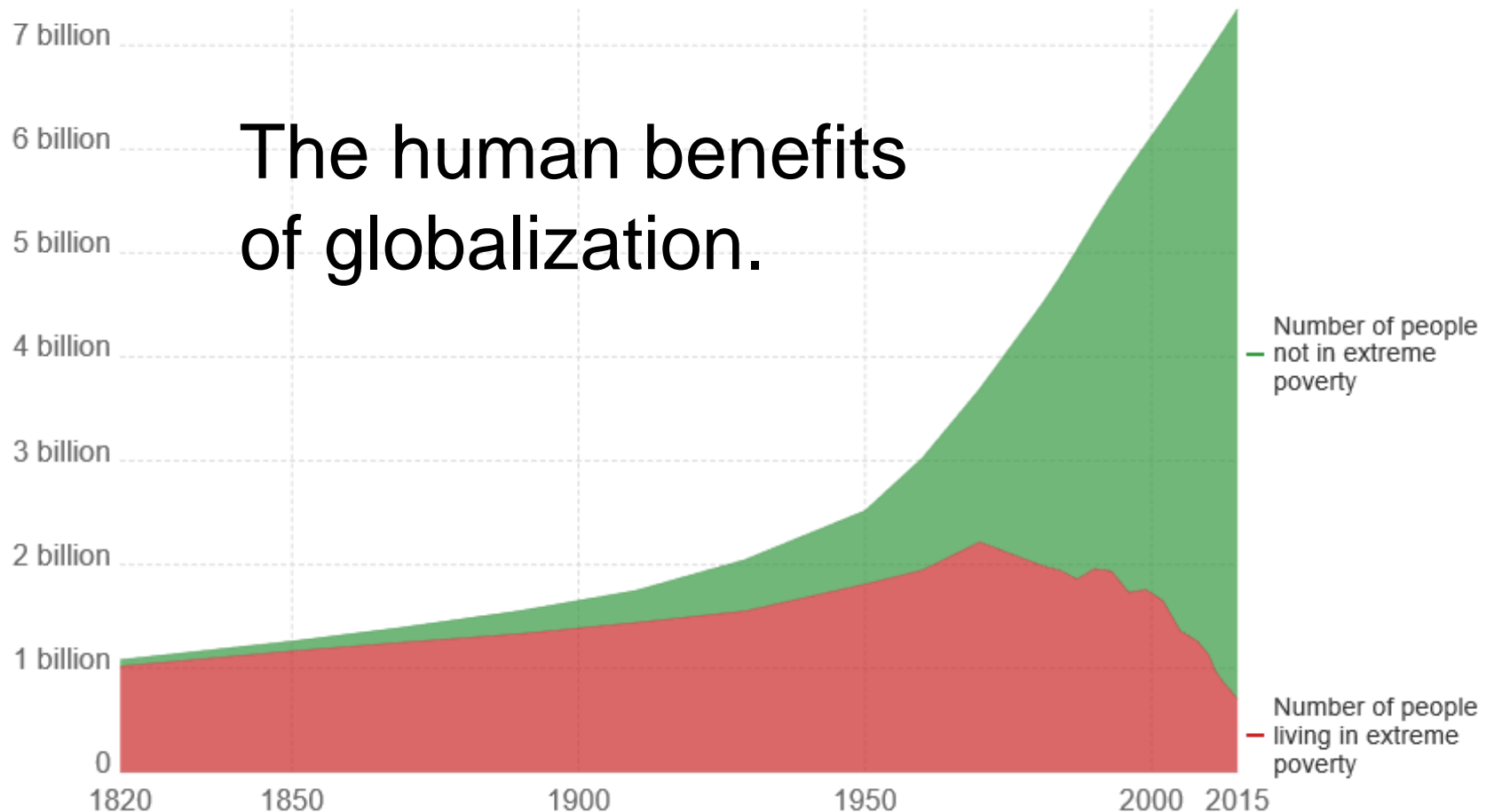
Globalization Era	Age of Discovery (15 th – 18 th Century)	Globalization 1.0 (19 th Century–1914)	Globalization 2.0 (1945-1989)	Globalization 3.0 (1989-2008)	Globalization 4.0
Leading Exports	 Raw Material / Basic Goods	 Textiles / Industrial Goods	 Factories	 Global Supply Chain	 Digital Goods / Services
Leading Nations					
Exports as % World GDP	 <5%	 6→14%	 5→15%	 15→>20%	
Enabling Era	Scientific Revolution (15 th – 17 th Century)	1 st Industrial Revolution (1780s-mid 19 th cent.)	2 nd Industrial Revolution (1870s-1910s)	3 rd Industrial Revolution (1960s-1990s)	4 th Industrial Revolution (2000s-2010s)
Enabling Innovations					
Characterizing GDP Trend	Europe ↗	Britain ↗↗	World ↗	United States ↗↗↗	China ↗↗↗↗

Per Capita Growth Seen by Most Nations



World population living in extreme poverty, 1820-2015

Extreme poverty is defined as living at a consumption (or income) level below 1.90 "international \$" per day. International \$ are adjusted for price differences between countries and for price changes over time (inflation).



Source: World Poverty in absolute numbers - OWID based on World Bank (2016) and Bourguignon and Morrisson (2002)
OurWorldInData.org/extreme-poverty/ • CC BY-SA



Emergence of push-back – growth of nationalism: Brexit; MAGA

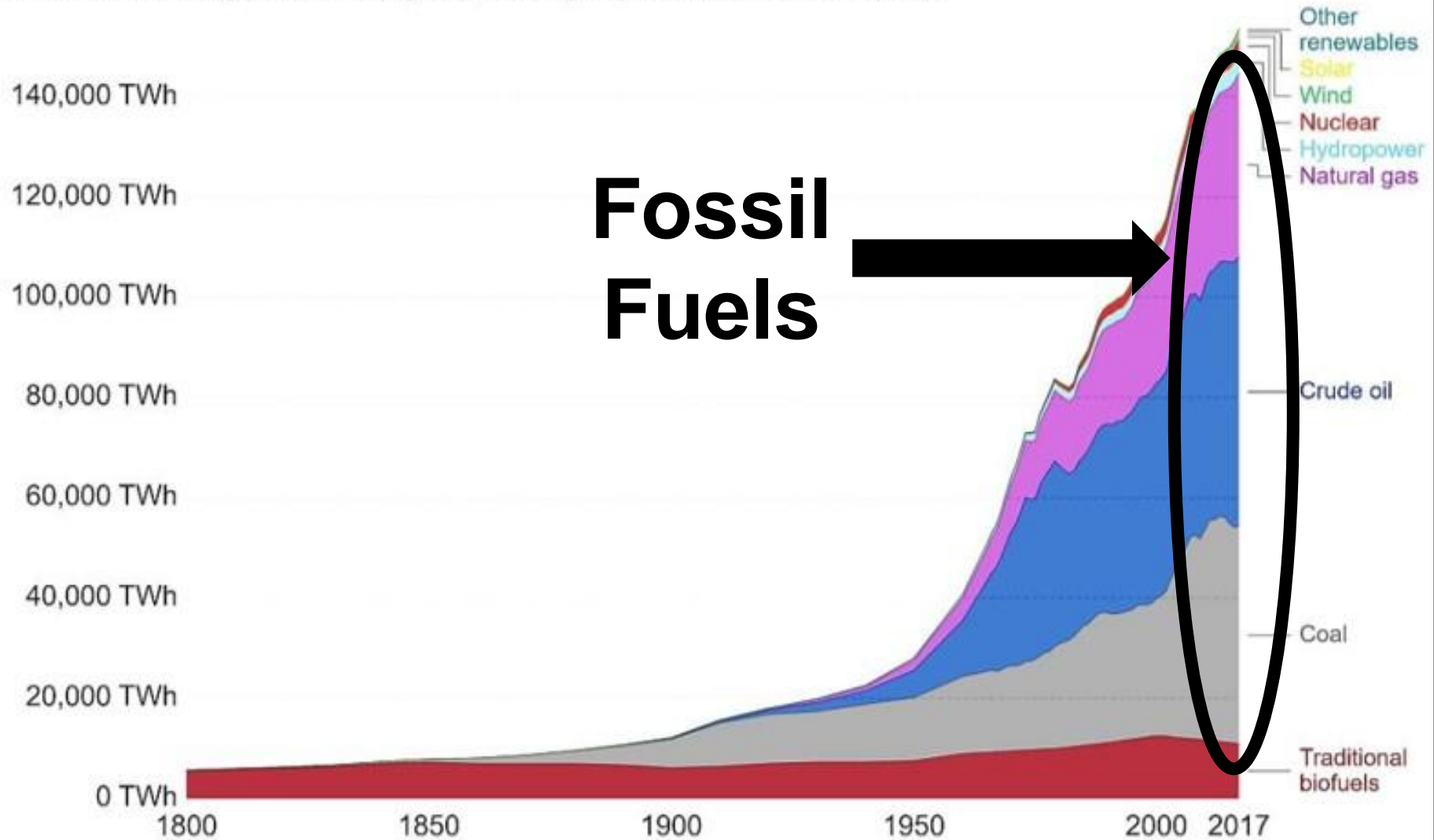
So What Has Allowed the US and World Economies to Grow as They Have?

**Cheap and Available
Energy!!**

Global primary energy consumption

Global primary energy consumption, measured in terawatt-hours (TWh) per year. Here 'other renewables' are renewable technologies not including solar, wind, hydropower and traditional biofuels.

Our World
in Data



Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

CC BY



An 1856 engraving from Harper's Monthly showing small whaling boats similar to those launched by crews off the Outer Banks in the nineteenth century. UNC-Chapel Hill Library.



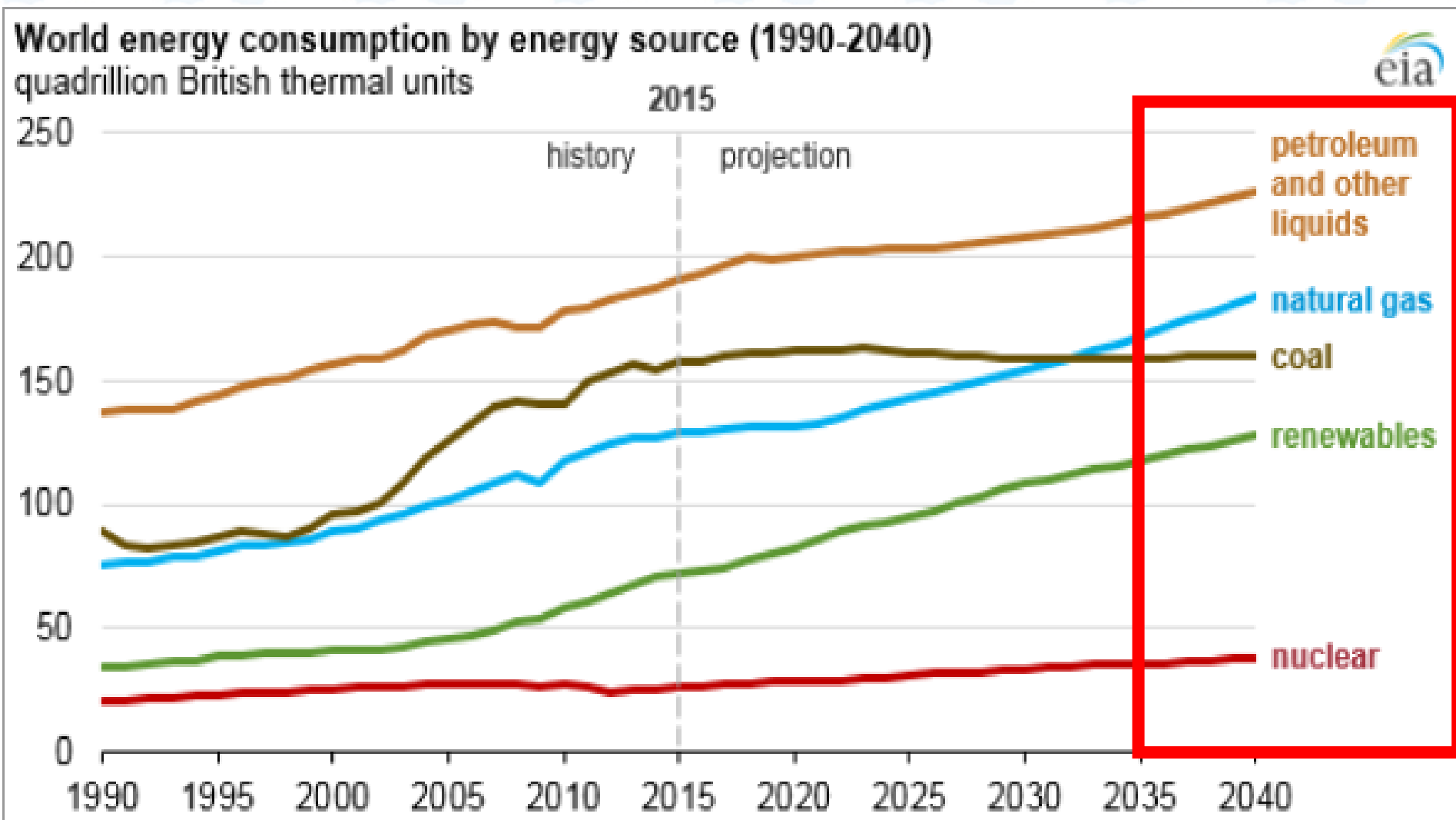
Col. Edwin L. Drake struck oil on Aug. 27, 1859

- 
- US consumes about 20M barrels of oil per day
 - 69% transportation and 26% industry
 - Electric vehicles will surpass fossil fuel vehicles in ~2038 (~40 M vehicles each sector)

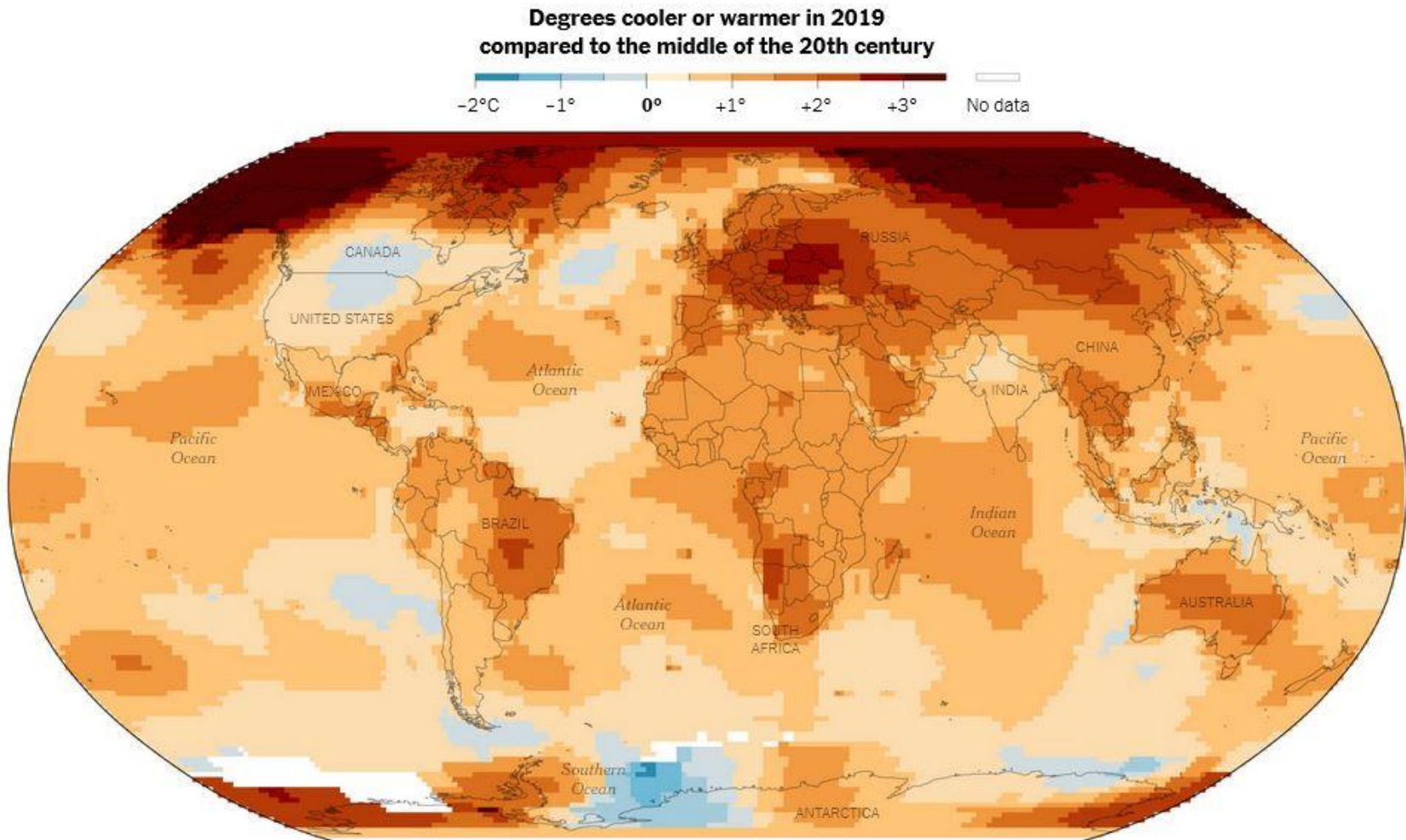
Sad to say fossil fuels in the US will be here for a while

1861 Vanity Fair cartoon where the whales are celebrating the discovery of oil in PA

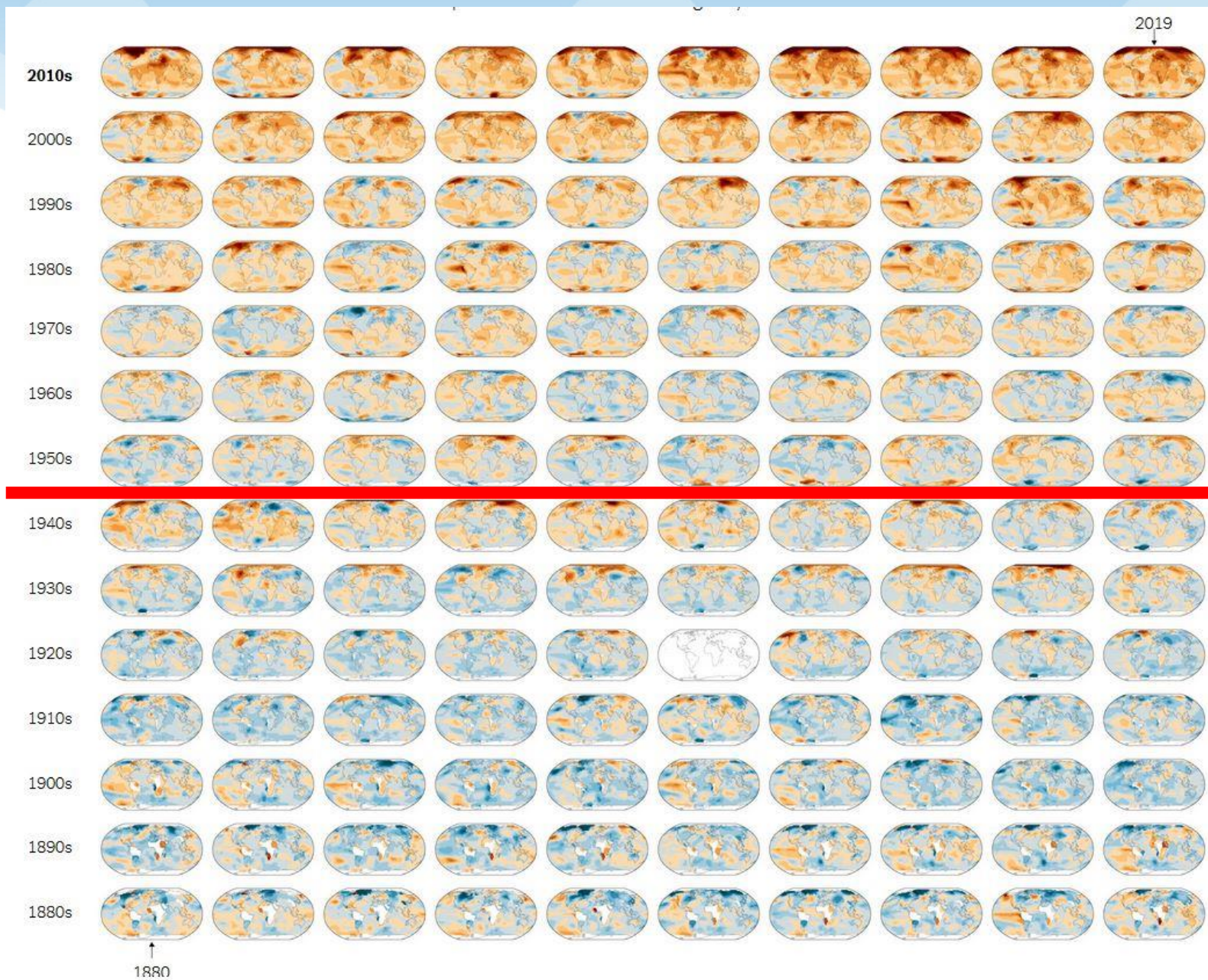
Global Energy Consumption




Oh - There is the Matter of Climate Change...



NYT Jan 15, 2020

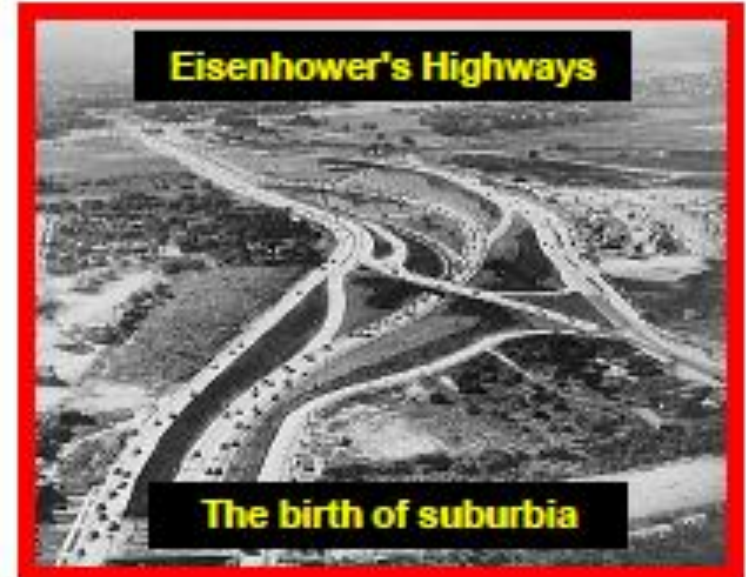




***What Lessons from
the American
Experience can we
Apply to These
Issues?***

1940s - 1950s

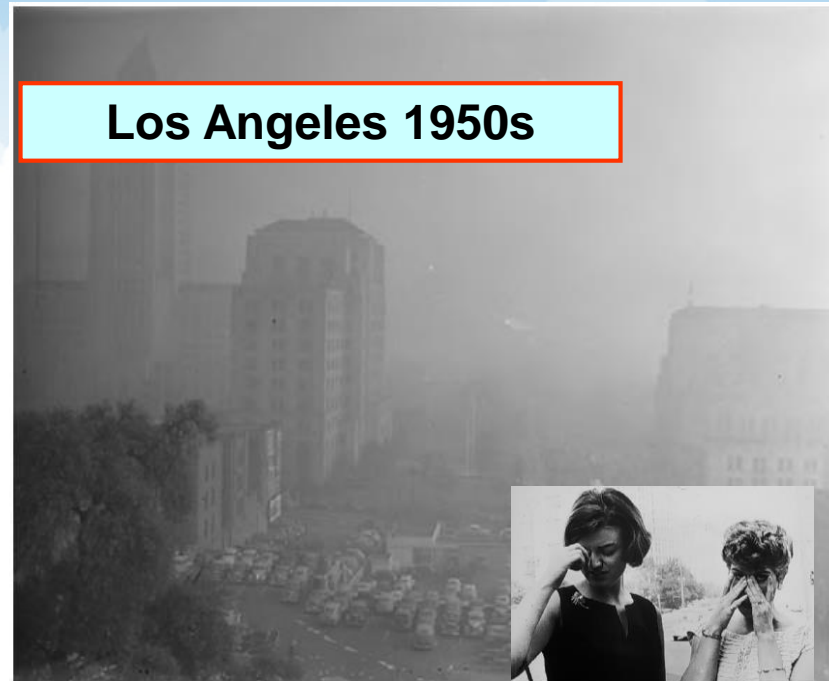
Post-War Industrialization and Growth



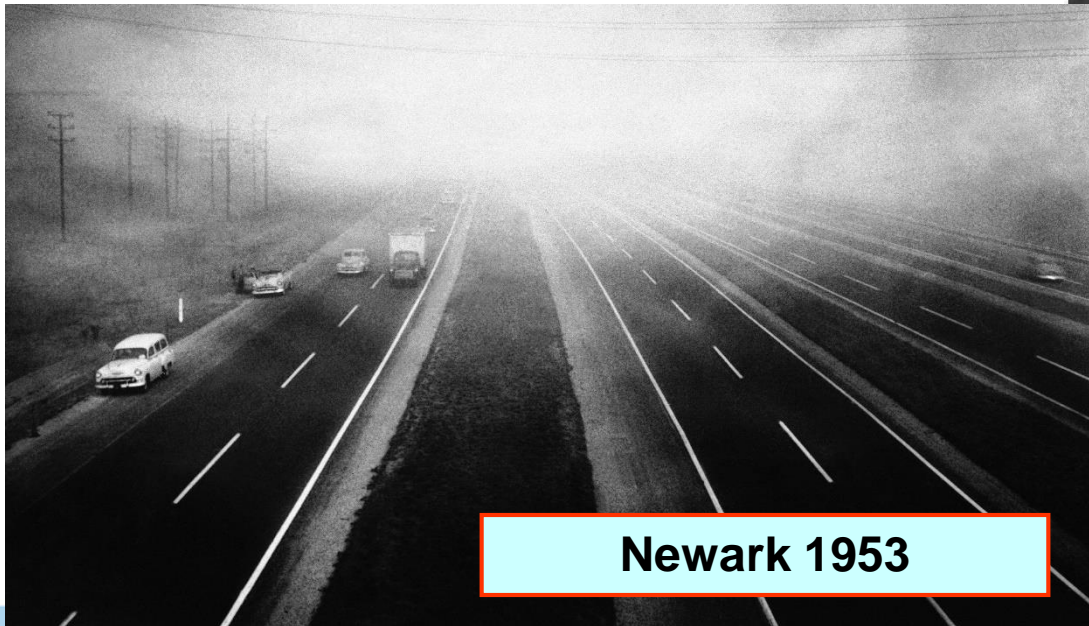
Smoke was a symbol of prosperity!



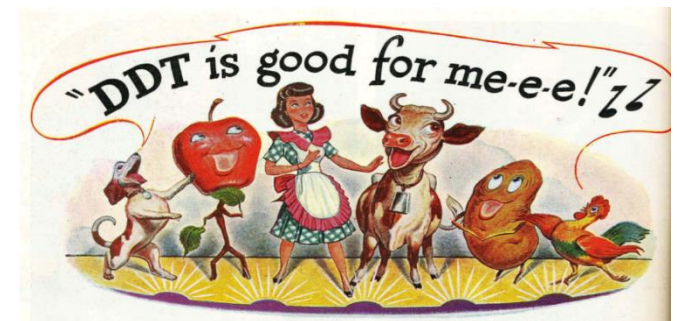
Donora PA 1948



Los Angeles 1950s



Newark 1953



**Ad in Time Magazine,
1947.**

Ugly Scenes Crept into the 1960's



Chattanooga Munitions Plant



Steubenville Steel Mill



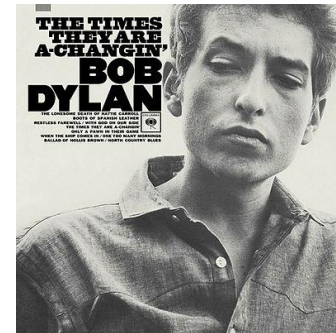
**Burn on the Cuyahoga
River, Cleveland**

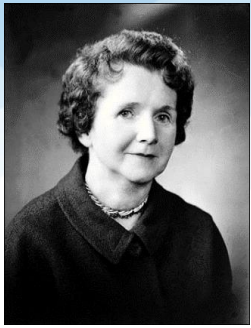


DC – Open Burning of dumps

Social Change on the Rise in the 1960s

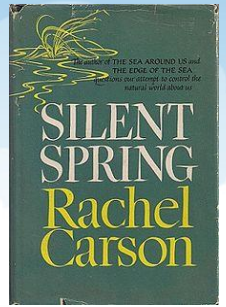
- **The WWII Generation and Baby-Boomers emerge**
 - New young and vibrant president with a bold vision
 - Challenges to the status quo and public outcry for change
 - Self-empowerment of the young boomers
- **Issues of the day**
 - Civil rights
 - Antiwar and military intervention
 - Anti-establishment (govt, corps, religion...anyone >30!)
 - Environmental awareness and fear of impacts
 - **Silent Spring – Rachel Carson**





Earth Day – April 22, 1970

**20 million people participated in
a national teach-in**



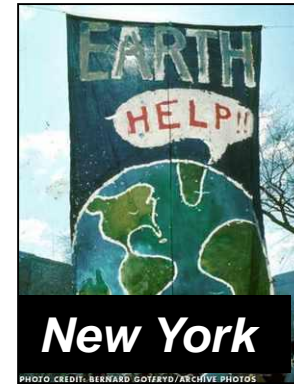
DC



Chicago



New Orleans



New York



Miami



Boston



Philadelphia

Believe it or Not...

- The birth of EPA in 1970 consolidated many disparate federal environmental efforts.
- The Clean Air Act 1970 established regulations for 6 “criteria” air pollutants within the first 5 months of EPA’s existence

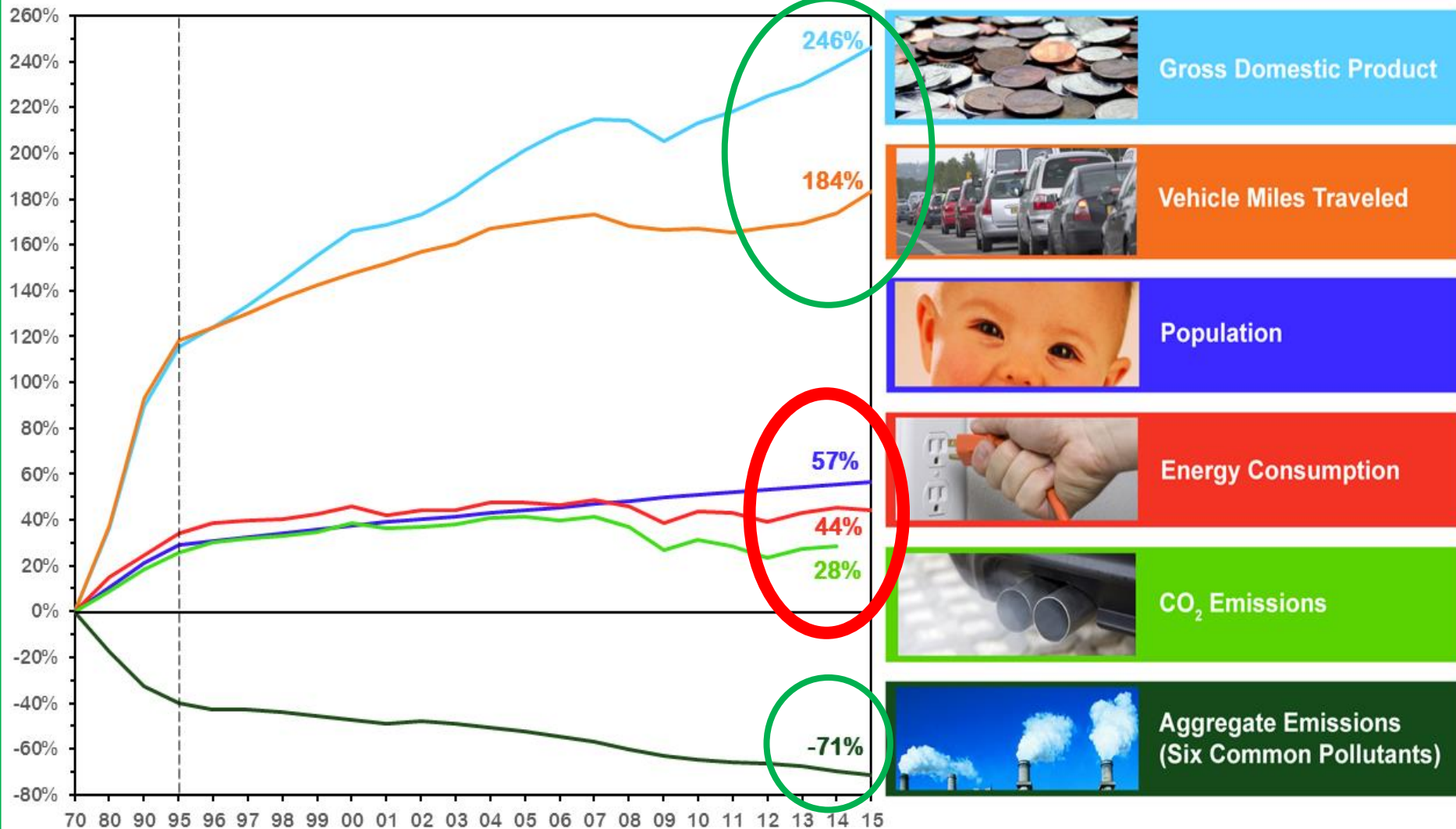


President
Richard M. Nixon



Back to Air, There is a Good News Story...

Comparison of Growth Areas and Emissions, 1970-2015



Public Distress with Health Consequences

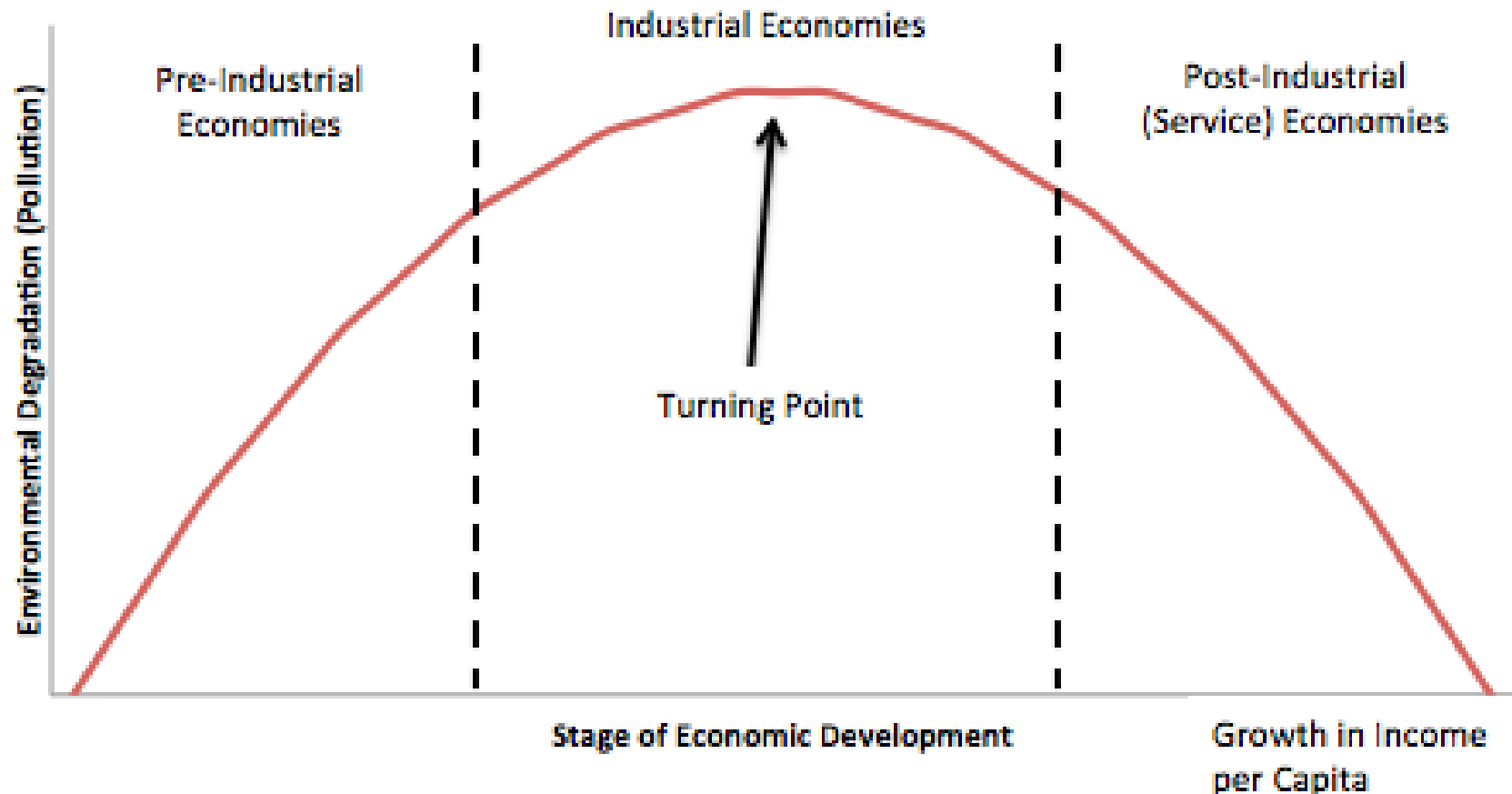


...and Economic Growth Drove Efforts to Clear the Air

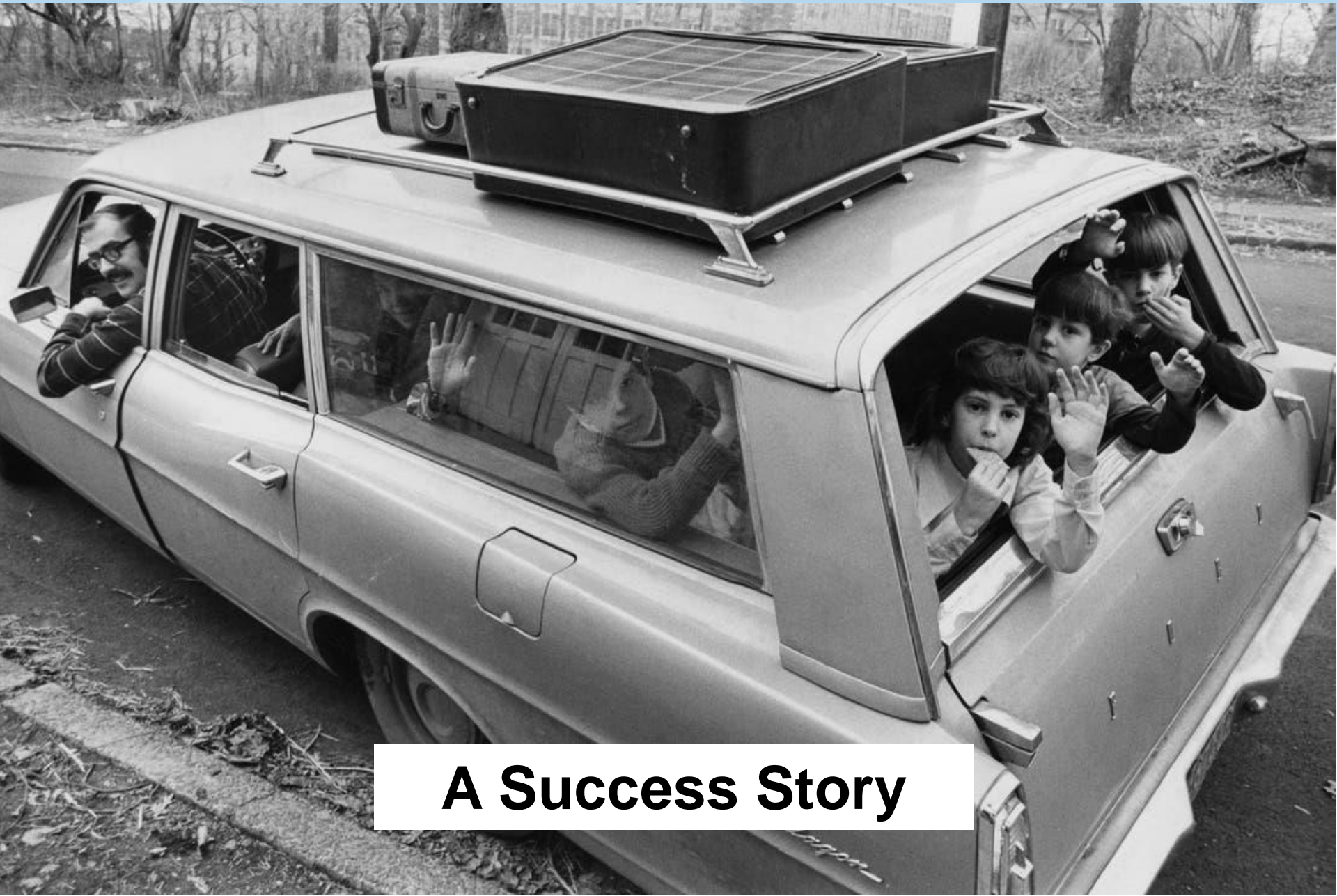


There a Model to Visualize this Process...

The Environmental Kuznets Curve



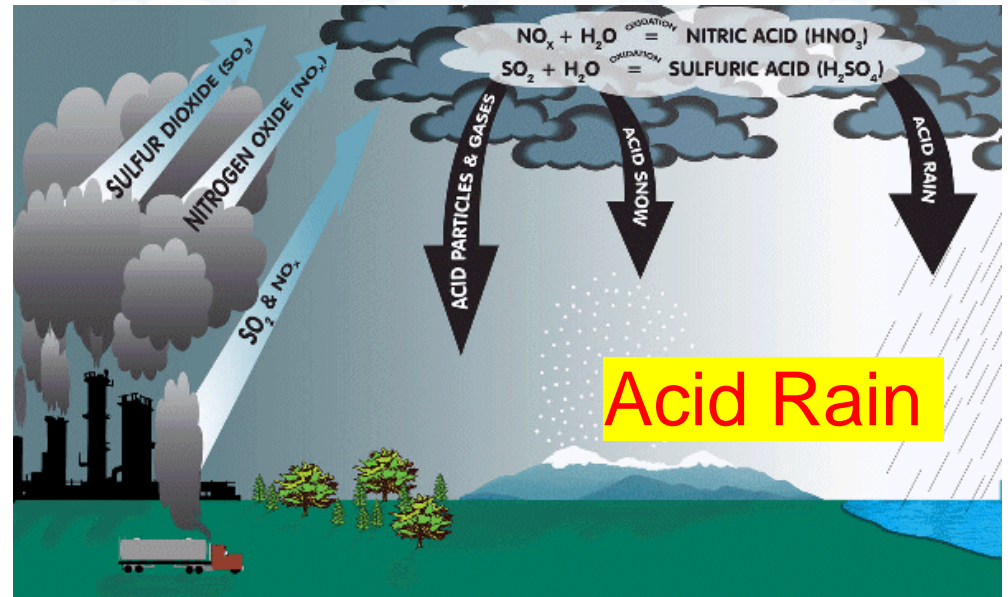
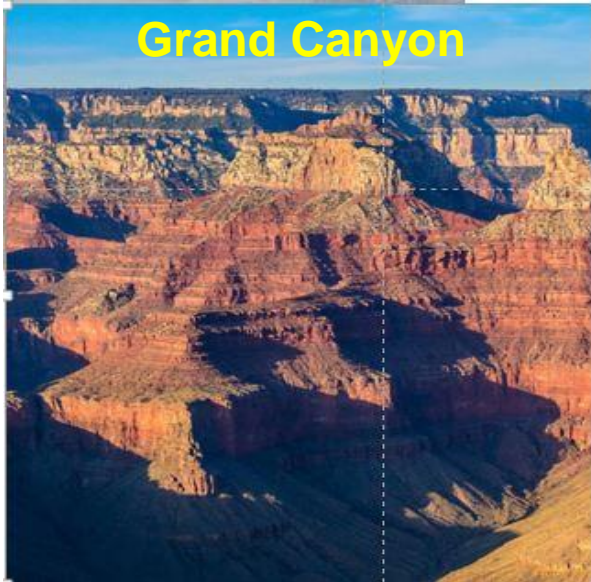
Simon Kuznets, 1950s



A Success Story

A Special Lesson from Sulfur in Fossil Fuel

Grand Canyon



National Parks



How Creativity, Cooperation and Courage Helped Clear the Air



C Boyden Gray
WH Counsel

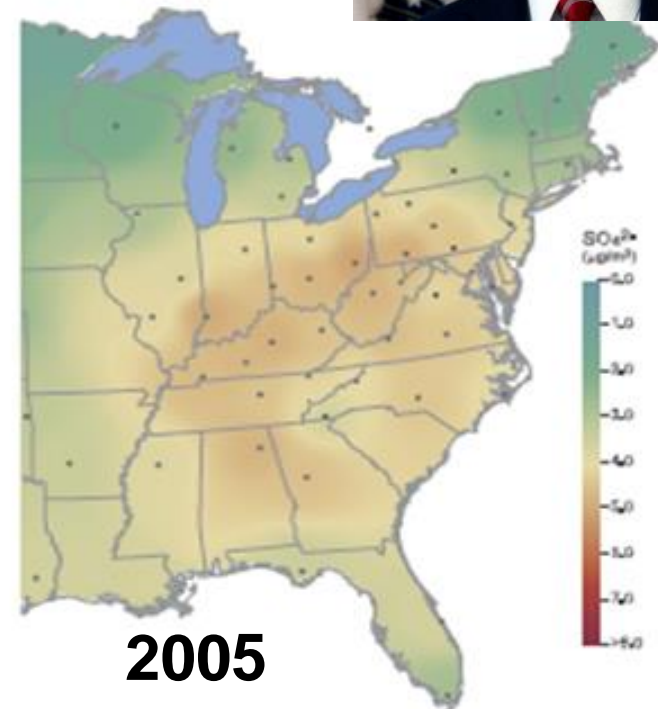
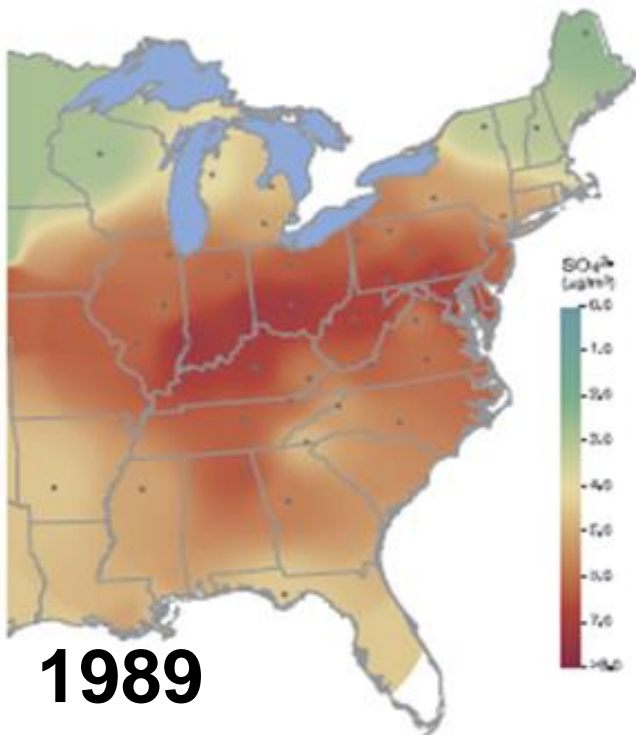


Fred Krupp
Envir Def Fund

How Creativity, Cooperation and Courage Helped Clear the Air

The Clean Air Act Amendments of 1990

- Targeted smoke reduction & lower sulfur coal and oil
- CAP & TRADE on sulfur had a dramatic effect





**Given what we know,
how might we meet the
multiple environmental
challenges ahead?**

CLIMATE CHANGE

“The interest in air pollution is proportional to what they can see.”

Sir Patrick Lawther (~1981)

Today's Reality

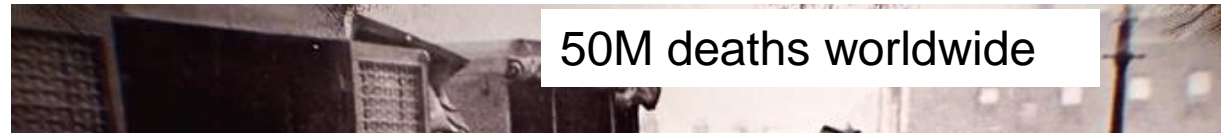
- COVID-19 provides a lesson
- Everything environmental is “systems”
- Disproportionate impacts – $f(\text{wealth}^{-n})$
- Climate change – finding an equilibrium
- Regulation alone is not likely to succeed
- Economic health = $f(\text{access to cheap energy})$
- We likely have the tools – do we have the courage?

Pandemics – A By-Product of Globalization

1855 Third Plague Pandemic

1875 Fiji Measles Pandemic


Columbian Exchange, 1492



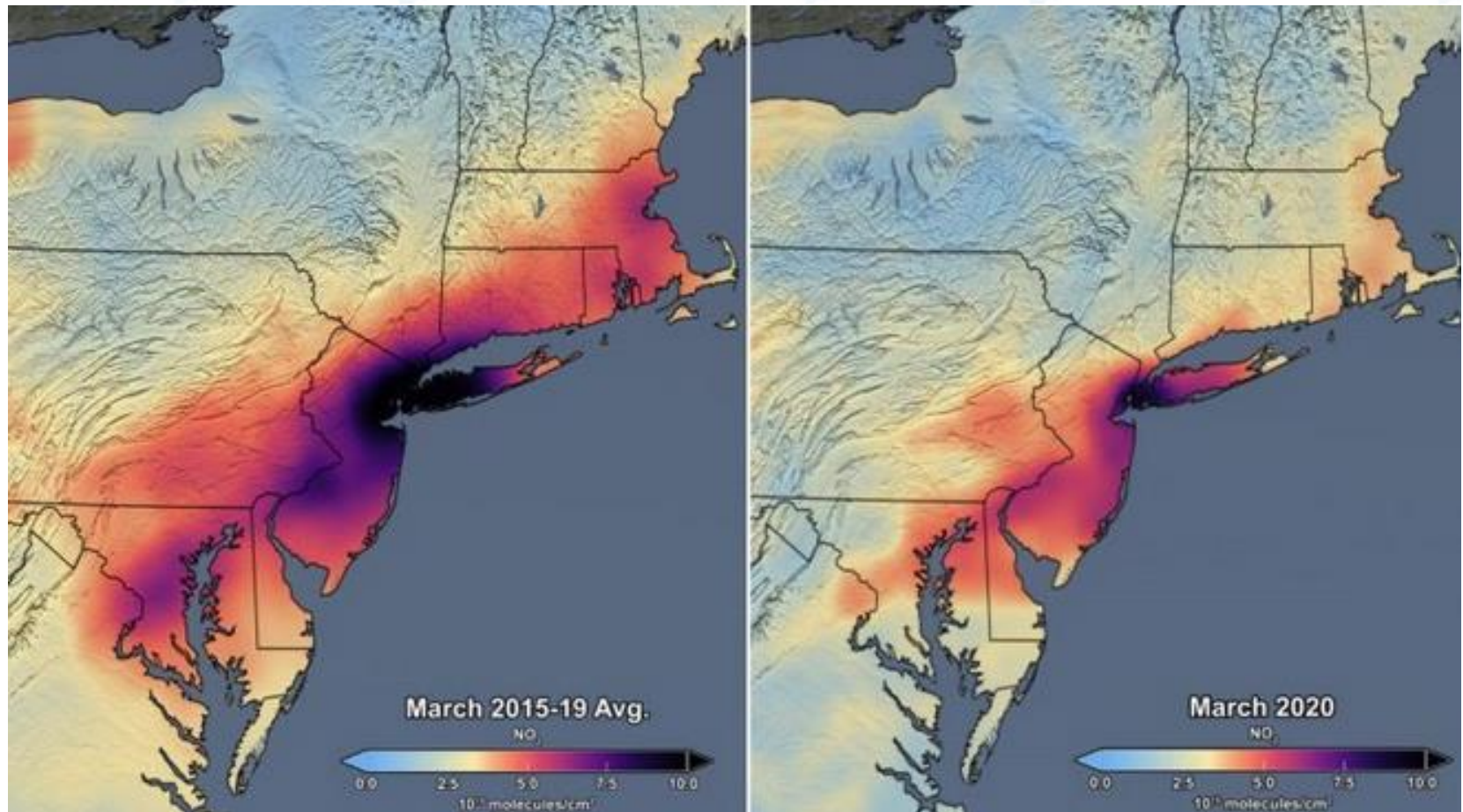
Preparedness versus Adaptation



1957 Asian Flu - 1.1M global deaths and 116K in US

1981 HIV – 75M infected and 32M deaths worldwide

Less Preferred Way to Pollution Reduction



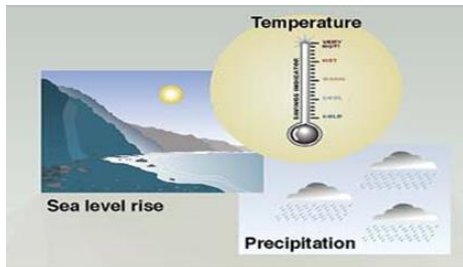
This image released by NASA shows the average concentration of atmospheric nitrogen dioxide in March of 2015-19. (left), compared to March of 2020. (NASA/NASA's Scientific Visualization Studio)

Nominal Public Health Impacts of Climate Change

INDIRECT

DIRECT

- Temp. rise
- Sea level rise
- Changes in Precipitation
- Storms



**International
Security
Issues**

HEAT

SEVERE WEATHER

AIR POLLUTION

ALLERGIES

VECTOR-BORNE DISEASES

WATER-BORNE DISEASES

WATER AND FOOD SUPPLY

MENTAL HEALTH

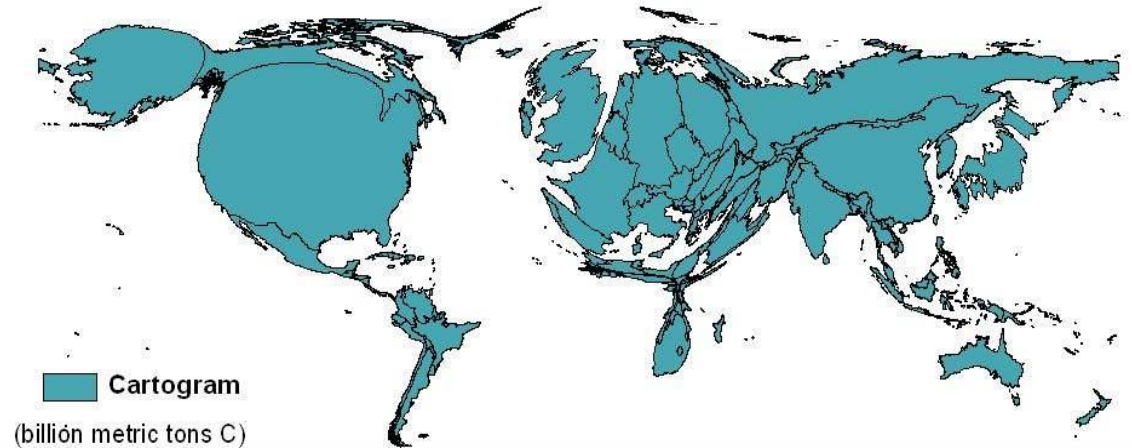
**ENVIRONMENTAL
REFUGEES**

ECOLOGICAL DISRUPTION

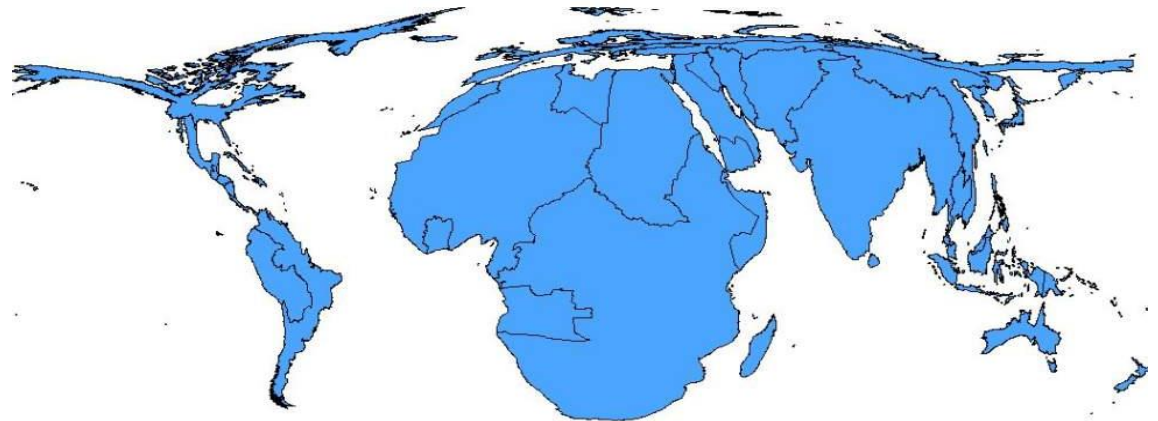
- ➔ Heat stress, cardiovascular failure, outdoor work stress
- ➔ Injuries, fatalities
- ➔ Asthma, cardiovascular disease
- ➔ Resp allergies, invasives
- ➔ Malaria, dengue, hantavirus, encephalitis,
- ➔ Cholera, cryptosporidiosis, campylobacter, leptospirosis
- ➔ Malnutrition, diarrhea, harmful algal blooms
- ➔ Anxiety, post-traumatic stress, depression, despair
- ➔ Forced migration, civil conflict
- ➔ Agricultural collapse

Climate Change and Global Health Inequity

Emissions of
greenhouse gases:



Estimated mortality
attributable to
climate change:



Source: McMichael J, 2008

EXAMPLE: Climate-Associated Coastal Storms Can Impact The Poor More, with Underappreciated Consequences

Florence and Michael Help Break State Records



Rural, Vulnerable Communities Heavily Impacted



Old Fort, NC



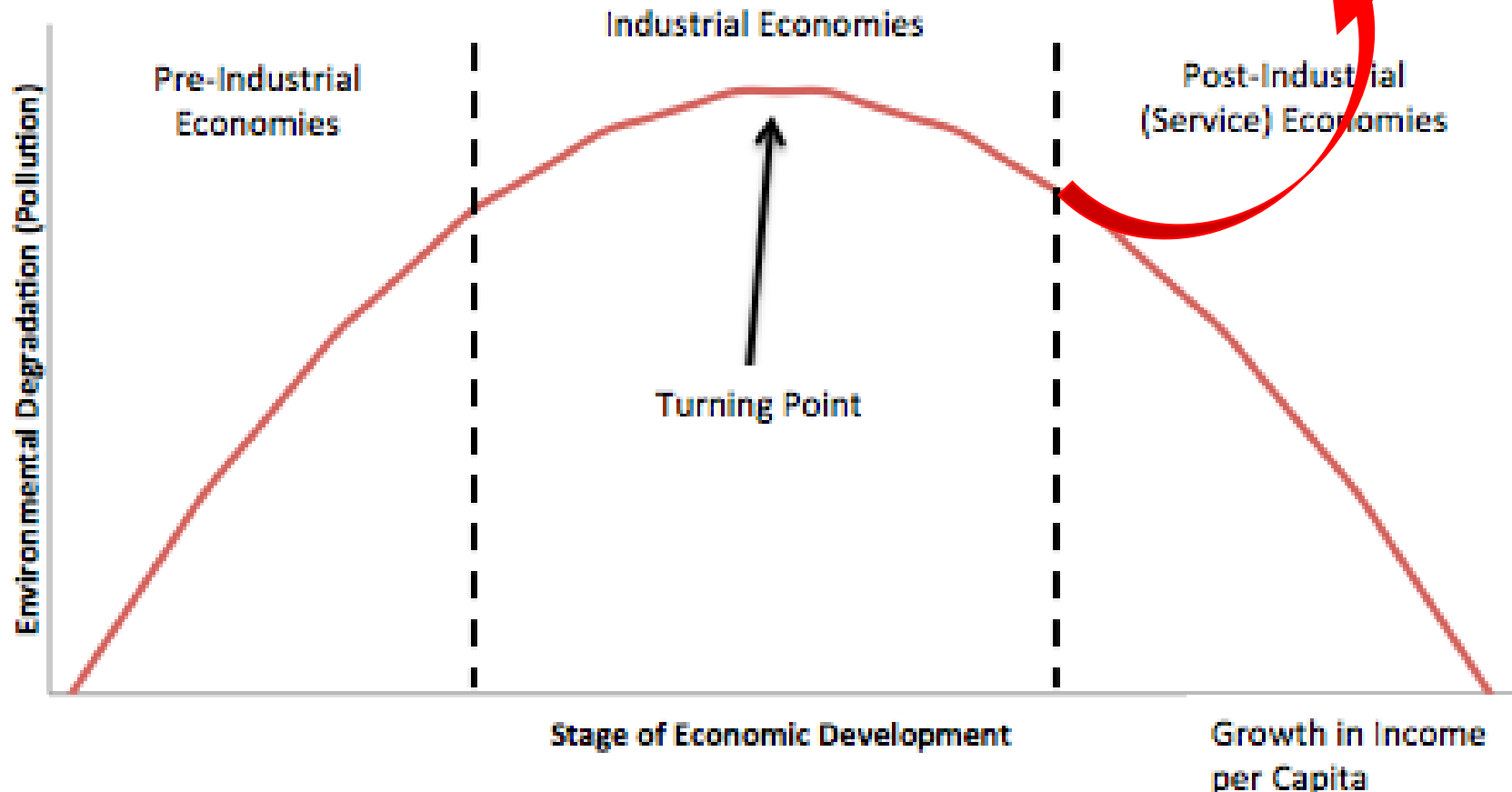
Boone, NC

Saluda, NC



Courtesy of Montana Eck, UNC

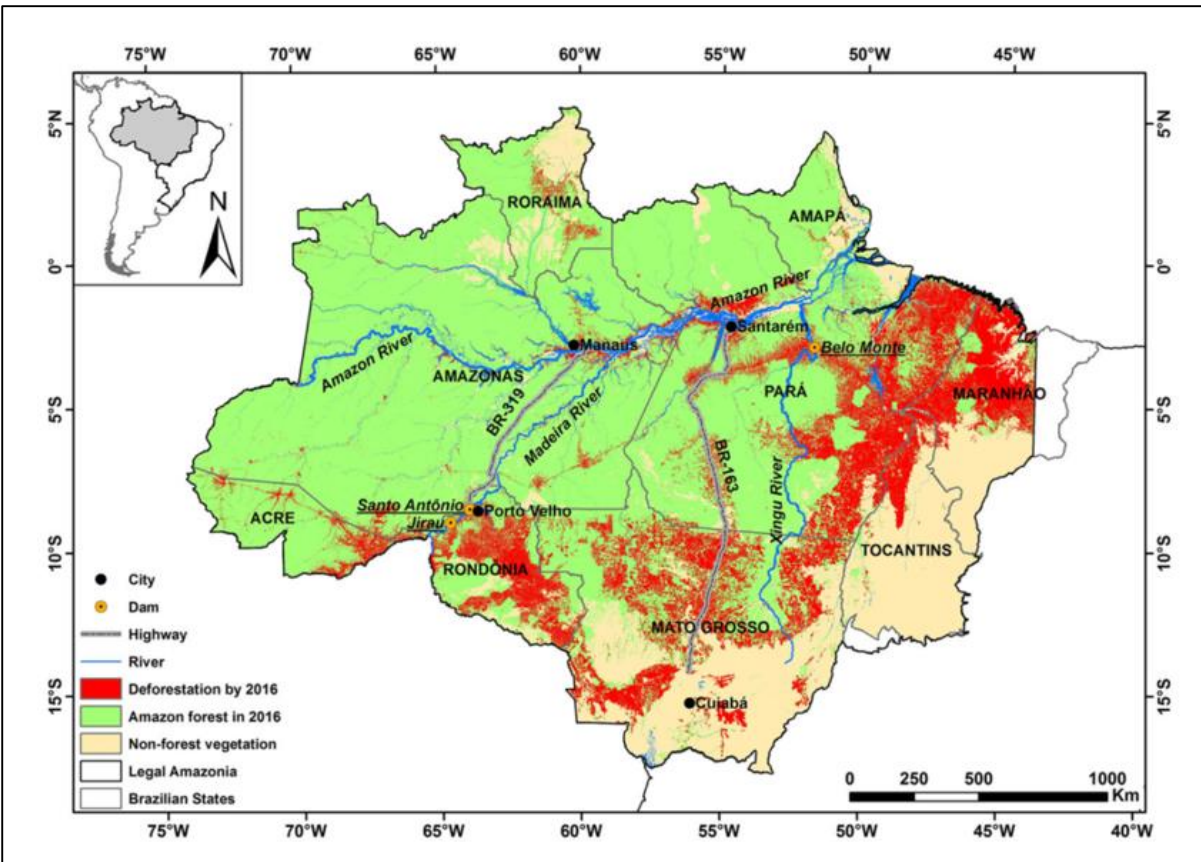
The Environmental Kuznets Curve



Climate Change is Different

Simon Kuznets, 1950s

The Interface of Globalization and Climate Change – Ground-Zero has to be the Amazon Rainforest



Delhi

The Ongoing Problem: Global Air Pollution

Beijing

Buenos Aires

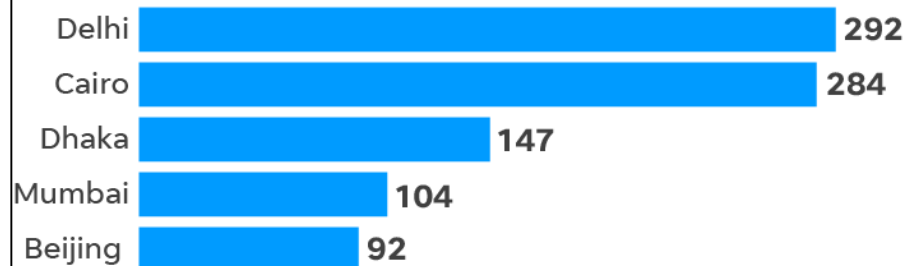
- 7.4 Billion people on earth
- 9 out of 10 people breath polluted air
- 7 million people/year die from air pollution
- Average global PM₁₀ level is 71 µg/M³

May 2, 2018
WHO news
release on air
pollution

Cairo

World's top 5 most polluted megacities

Based on the number of particles of pollution per cubic meter. Megacities are those with at least 14 million people.



SOURCE World Health Organization, 2010-2016
Frank Pompa/USA TODAY

3B breath smoke
from cook stoves



4.3M deaths



Electrification is Still the Goal.



Transition to Renewables

The Wickedness in the Problem Brings Out the Best of Us

Millennials will be the last generation to act on climate and the first to fully experience the full tipping of change



Chloe Maxmin

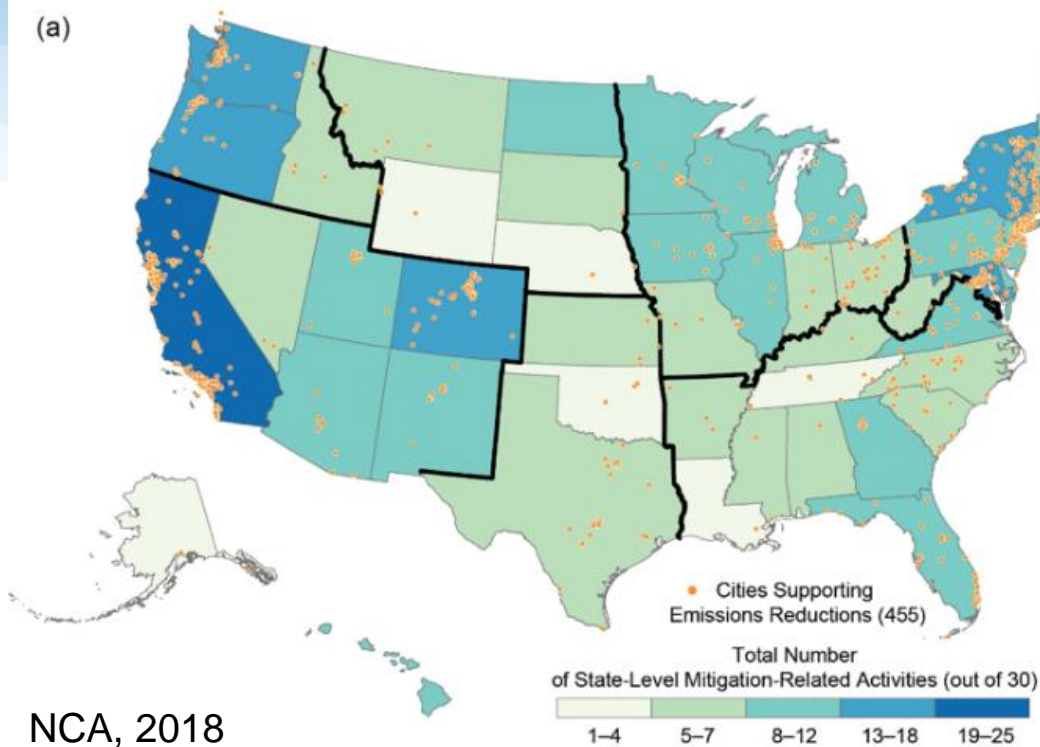


Greta Thunberg



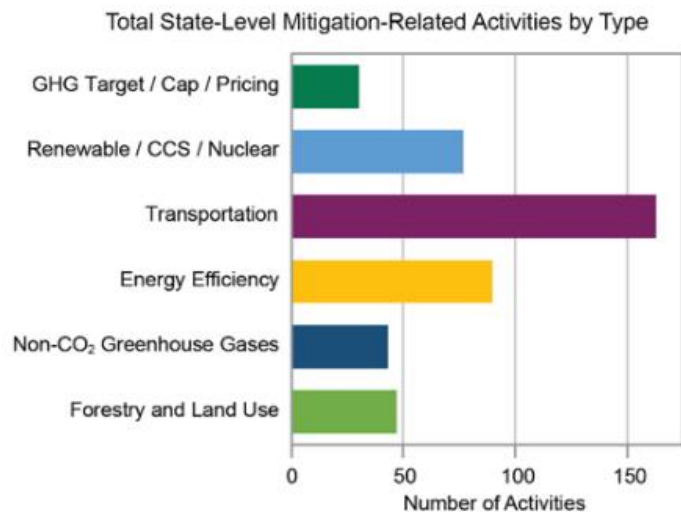
Julianna vs US government

(a)



NCA, 2018

(b)



Cities Take Action



Public Action

Cap & Trade / Soc Cost of Carbon?

Bold Free-Market Action

Using the SCC to Calculate Costs and Benefits of Changing Emissions

Policy A Scenario



← **Policy A**
Increases emissions
by 500,000 tons

$$500,000 \text{ tons CO}_2 \times \$50 \text{ per ton CO}_2 = \$25,000,000$$

Increase in emissions due to Policy A *SCC* *Cost of Policy A due to added emissions*

Baseline Scenario



→ **Policy B**
Decreases emissions
by 500,000 tons

$$500,000 \text{ tons CO}_2 \times \$50 \text{ per ton CO}_2 = \$25,000,000$$

Decrease in emissions due to Policy B *SCC* *Benefit of Policy B due to decrease in emissions*

Policy B Scenario



In this example, the social cost of carbon has been calculated to be **\$50 per ton of CO₂**.

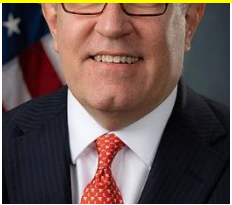
Some form of this approach has been proposed by most economists.

Where is the US Leadership?

CBS 60 Minutes (Oct 14) - Comments on climate change:

“most of the threats from climate change are 50 to 75 years out.”








– [Andrew Wheeler, April, 2019]



"EPA has been working hard to fulfill President Trump's promise to cut burdensome and ineffective regulations for our domestic energy industry." [Methane Decision 8/14/2020]

- Andrew Wheeler

Administration Efforts to Deregulate

	58	37	95
	ROLLBACKS COMPLETED	ROLLBACKS IN PROCESS	TOTAL ROLLBACKS
 Air pollution and emissions	16	9	25
 Drilling and extraction	10	9	19
 Infrastructure and planning	11	1	12
 Animals	7	3	10
 Toxic substances and safety	5	3	8
 Water pollution	4	6	10
 Other	5	6	11

Unexpected Environmental Heroes



“Shall we surrender to our surroundings or shall we make our peace with nature and begin to make reparations for the damage we have done to our air, to our land and to our water?”

- Richard Nixon

State of the Union Message, 22 Jan 1970



Too many Americans continue to breathe dirty air. And political paralysis has plagued further progress against air pollution...”

- George H. W. Bush

...upon signing the CAAA Nov 15, 1990

But What About Us?



You cannot affirm the power plant and condemn the smokestack, or affirm the smoke and condemn the cough.

—Wendell Berry, *The Gift of the Good Land*, 1981.

World avg electricity consumption
KW/capita/yr 2,674

USA 12,071

India 1,181

China 4,475

Egypt 1,510

Russia 7,481

Liberia 69



And when our children's children look us in the eye and ask if we did all we could to leave them a safer, more stable world, with new sources of energy, I want us to be able to say yes, we did.

- Barack Obama

State of the Union Message

Jan 28, 2014



Thank You

A photograph of a sunset over a beach. The sun is low on the horizon, casting a bright orange glow across the sky and reflecting on the wet sand and water. Silhouettes of buildings are visible in the background.

**Good environmental policy is a fabric woven with the
threads of science**