

Climate Change Solutions/Policy Options

October 29, 2019

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The Healthy Environment Alliance of Utah
www.healutah.org

***Climate Changes Health and Health Equity
Fall 2019 Community Read/Journal Club Discussion
Eccles Health Sciences Library
Office of Health Equity and Inclusion***



Or,
as Mark Twain once said

Everyone Talks About the Weather
But No One Does
Anything About It

Actually he plagiarized it. False News!



Healthy Environmental ALliance of Utah



Air Quality



Renewable Energy &
Climate Change



Radioactive
Waste

- Established as a 501c3 in 1999
- 20,000 Supporters
- \$500,000 annual budget
 - 50% Foundation Grants
 - 50% Supporter Donations
- 6.5 FTE staff
- 10 Member Board
- Content Expert Advisors

Scott's Medical Career

University of Utah Department of Pediatrics (12 yrs) ->

Utah State Department of Health (12 yrs)->

MountainStar Healthcare (8 yrs) ->

Retired (2 yrs)->

HEAL Utah (2 yrs)- Why?





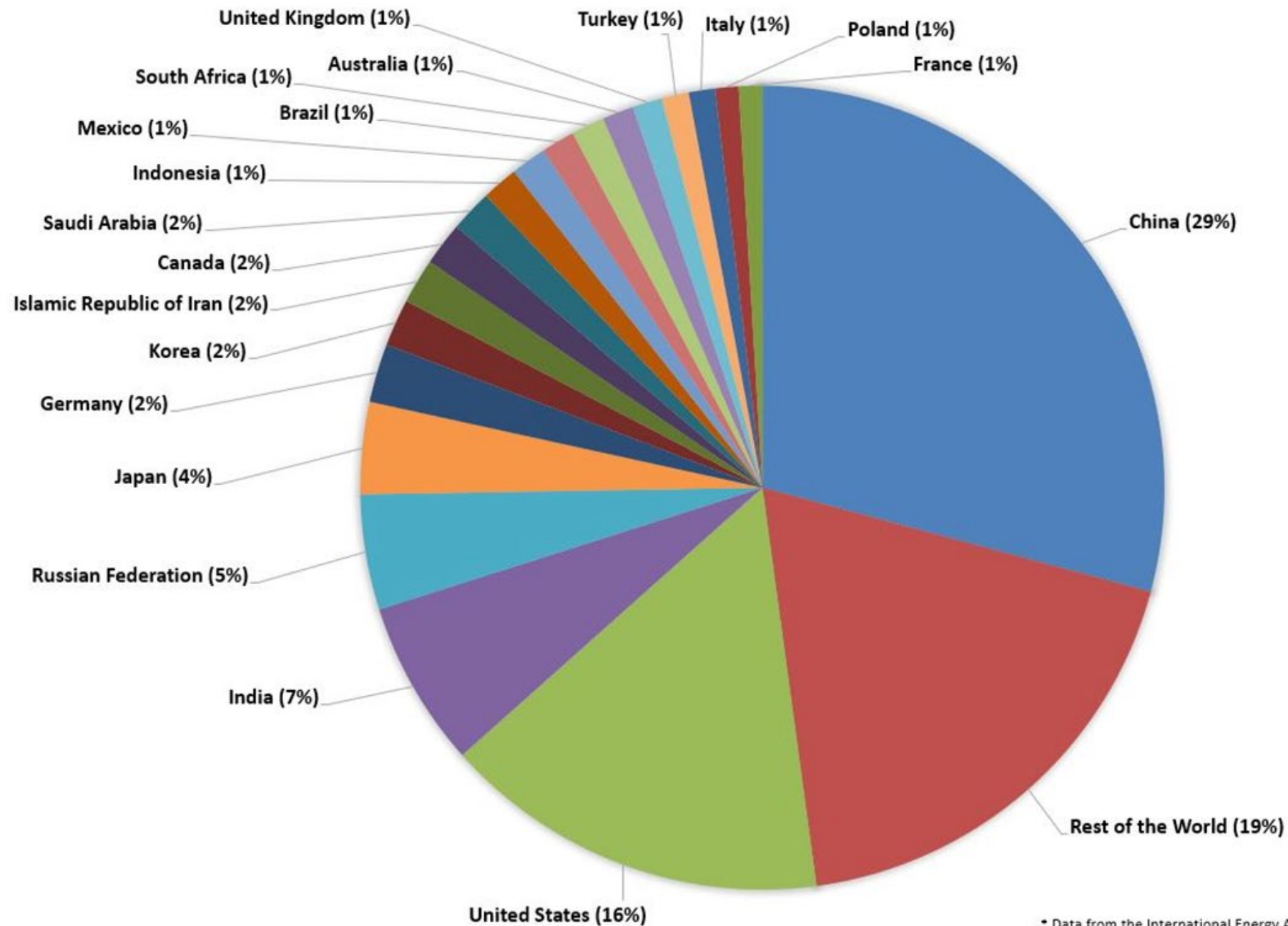
Climate Change Solutions/Policy Options

Relative potency of greenhouse gases

<https://www.ipcc.ch/report/ar4/wg1/>

Greenhouse gas	Chemical formula	Major sources	Global Warming Potential, 100-year comparison	Atmospheric Lifetime (years)	Pre-industrial concentration (ppb)	2011 concentration (ppb)
Carbon Dioxide	CO ₂	Fossil fuel combustion; Deforestation; Cement production	1	100*	278,000	390,000 (in 2011)
Methane	CH ₄	Fossil fuel production; Agriculture; Landfills	25	12	722	1,803 (in 2011)
Nitrous Oxide	N ₂ O	Fertilizer application; Fossil fuel and biomass combustion; Industrial processes	298	114	271	324 (in 2011)
Chlorofluorocarbon-12 (CFC-12)	CCl ₂ F ₂	Refrigerants	10,900	100	0	0.527
Hydrofluorocarbon-23 (HFC-23)	CHF ₃	Refrigerants	14,800	270	0	0.024
Sulfur Hexafluoride	SF ₆	Electricity transmission	22,800	3,200	0	0.0073
Nitrogen Trifluoride	NF ₃	Semiconductor manufacturing	17,200	740	0	0.00086

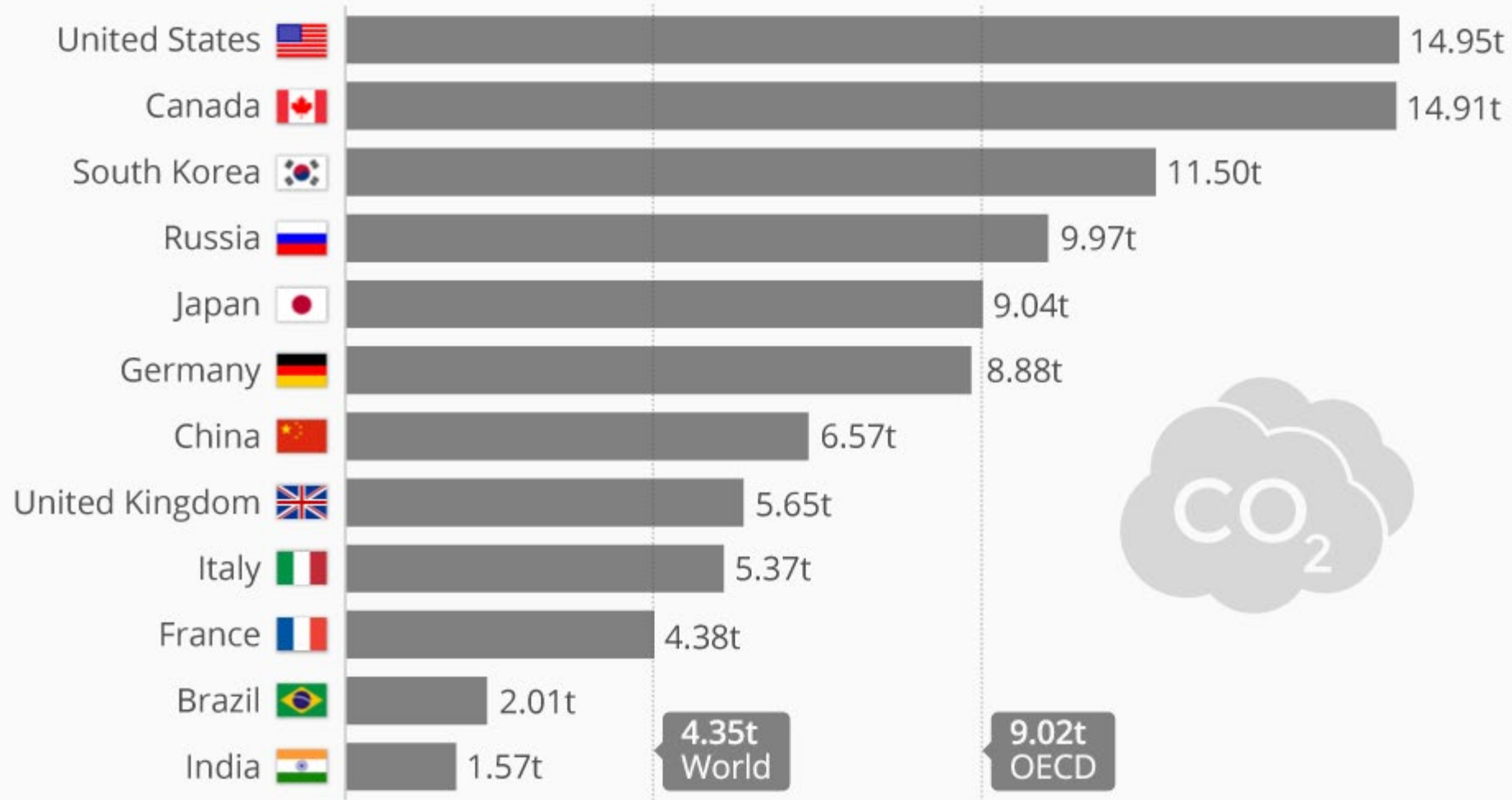
2016 COUNTRY EMISSIONS PERCENTAGES (GTCO2)



* Data from the International Energy Agency CO2 Emissions from Fuel Combustion Highlights, 2018 edition

The Global Disparity in Carbon Footprints

Per capita CO₂ emissions in the world's largest economies in 2016* (in metric tons)



@StatistaCharts

* countries chosen based on 2017 nominal GDP

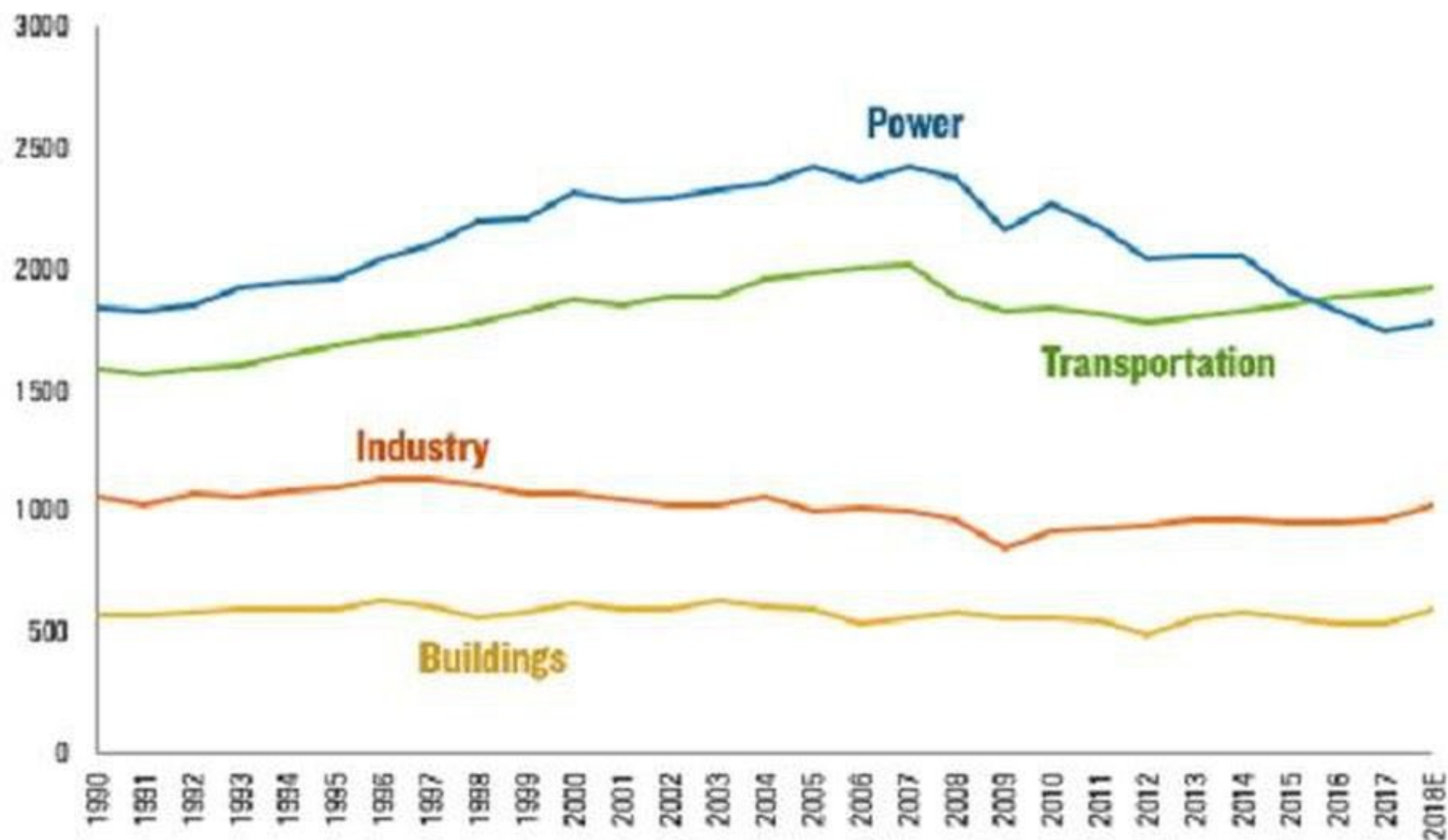
Sources: International Energy Agency, International Monetary Fund

statista

HEAL
UTAH POWERING ACTION
TO PROTECT UTAH

Figure 4: Energy-related CO₂ emissions by sector

Million metric tons



Source: Rhodium US Climate Service

UNCHARTED TERRITORY

400,000 Years of Carbon Dioxide

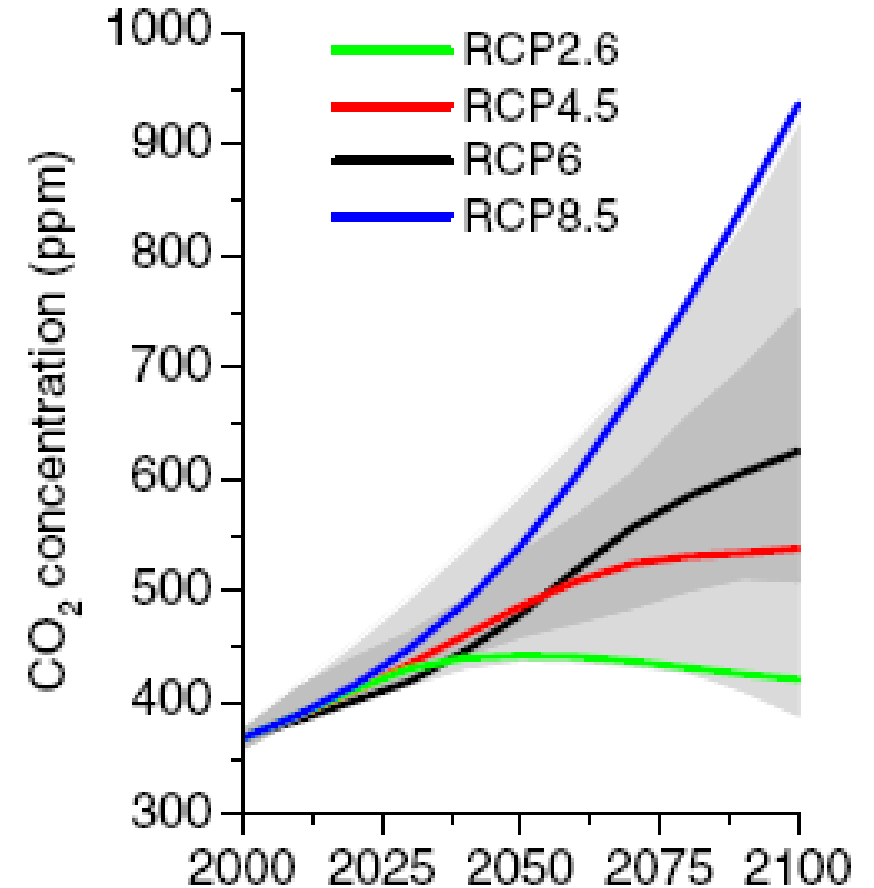
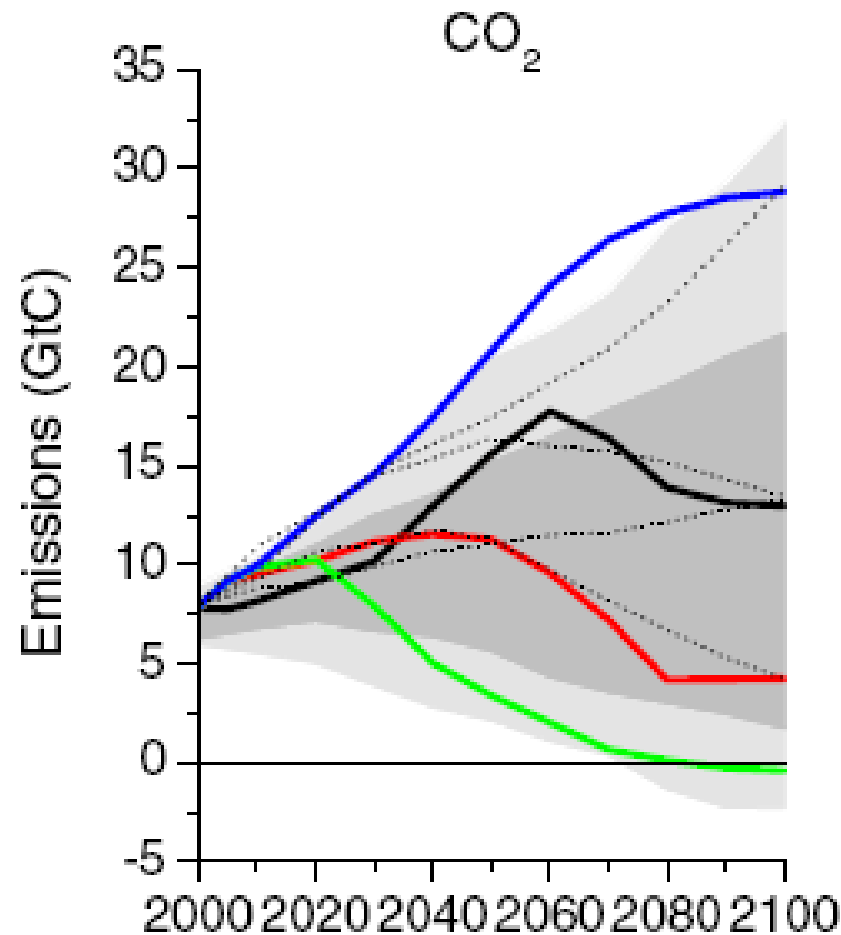


Source: Luthi et al (2008) (cdiac.ornl.gov) & Keeling et al (Scripps.ucsd.edu)

CLIMATE CO₂ CENTRAL

Intergovernmental
Panel on Climate
Change (IPCC)
Report 5- 2013
Report 6-2022

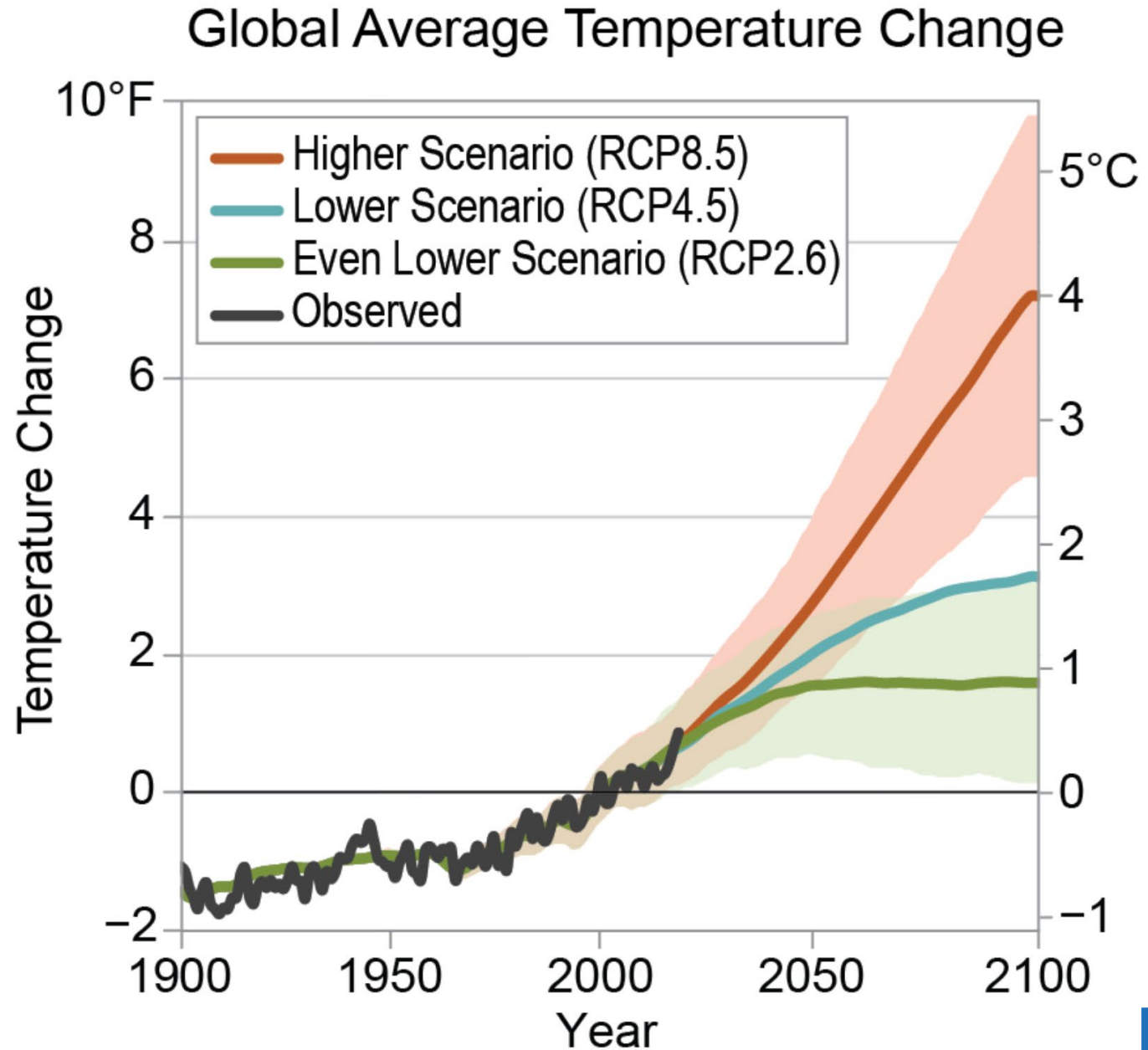
Representative
Concentration
Pathways (RCPs)



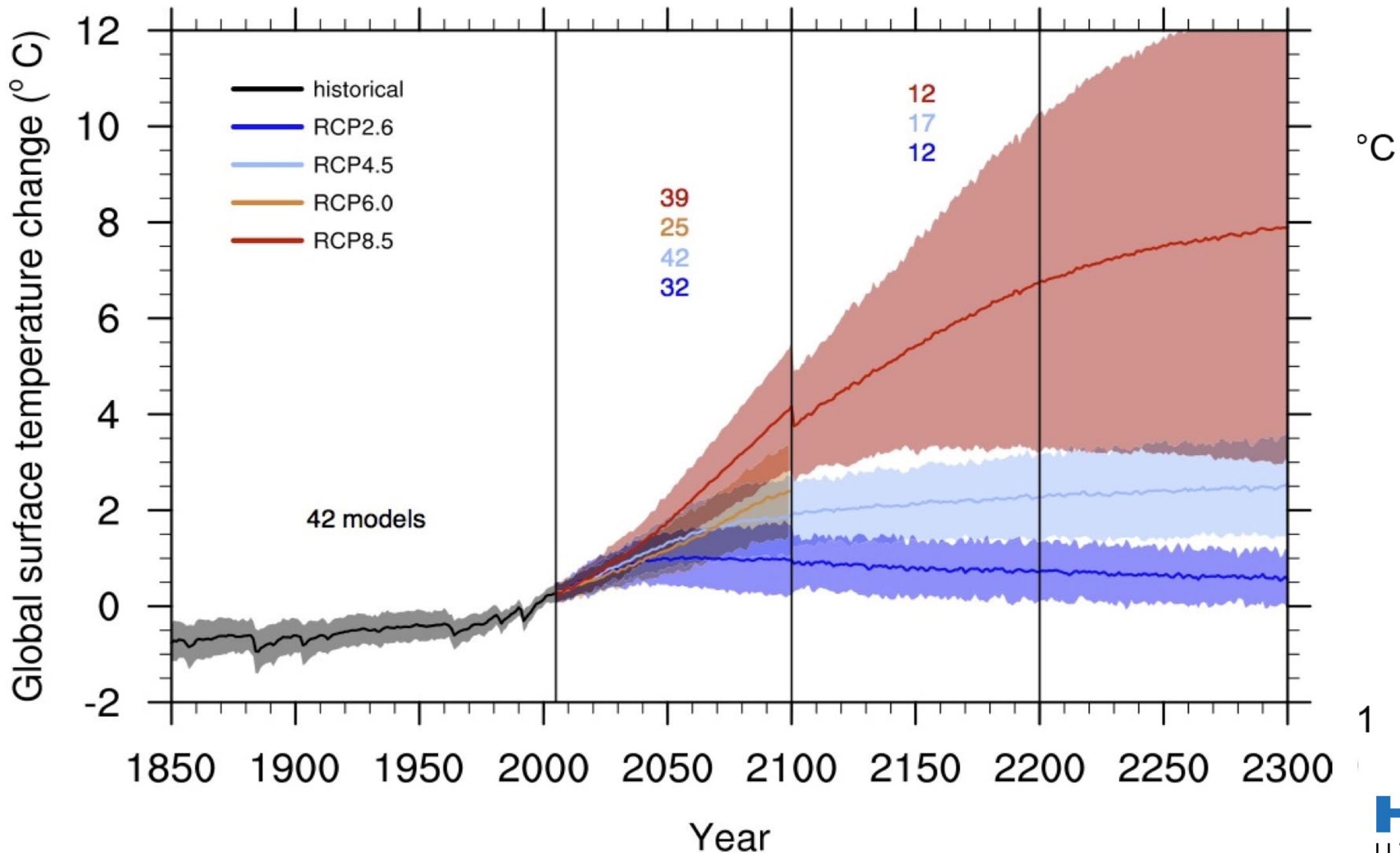
<https://www.theguardian.com/environment/climate-consensus-97-per-cent/2013/aug/30/climate-change-rcp-hand-y-summary>

IPCC-
Intergovernmental
Panel on Climate
Change
Report 5- 2013
Report 6-2022

RCPs-
Representative
Concentration
Pathways



<https://medium.com/@davidfurphy/what-on-earth-is-an-rcp-bbb206ddee26>



<https://medium.com/@davidturphy/what-on-earth-is-an-rcp-bbb206ddee26>

Health Impacts of Climate Change

<https://www.nejm.org/doi/full/10.1056/NEJMp1906035>

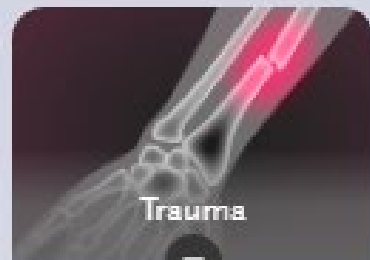
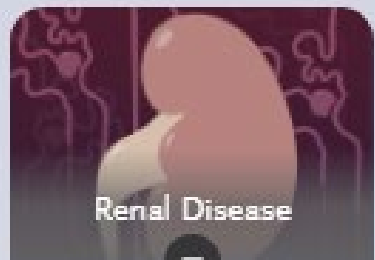
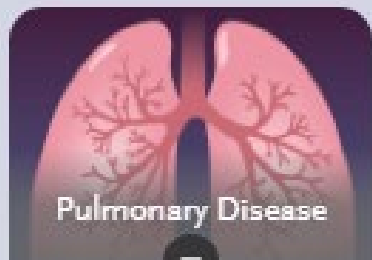
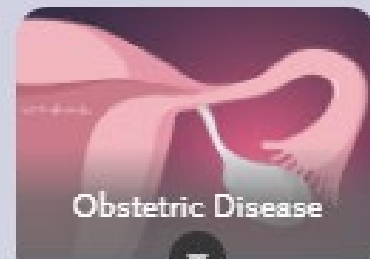
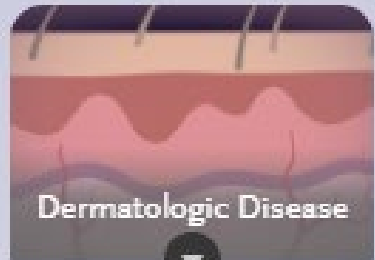
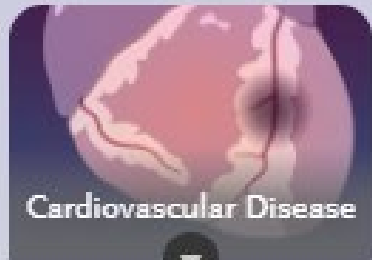


Figure 1: Climate Change is Harming the Health of Americans.

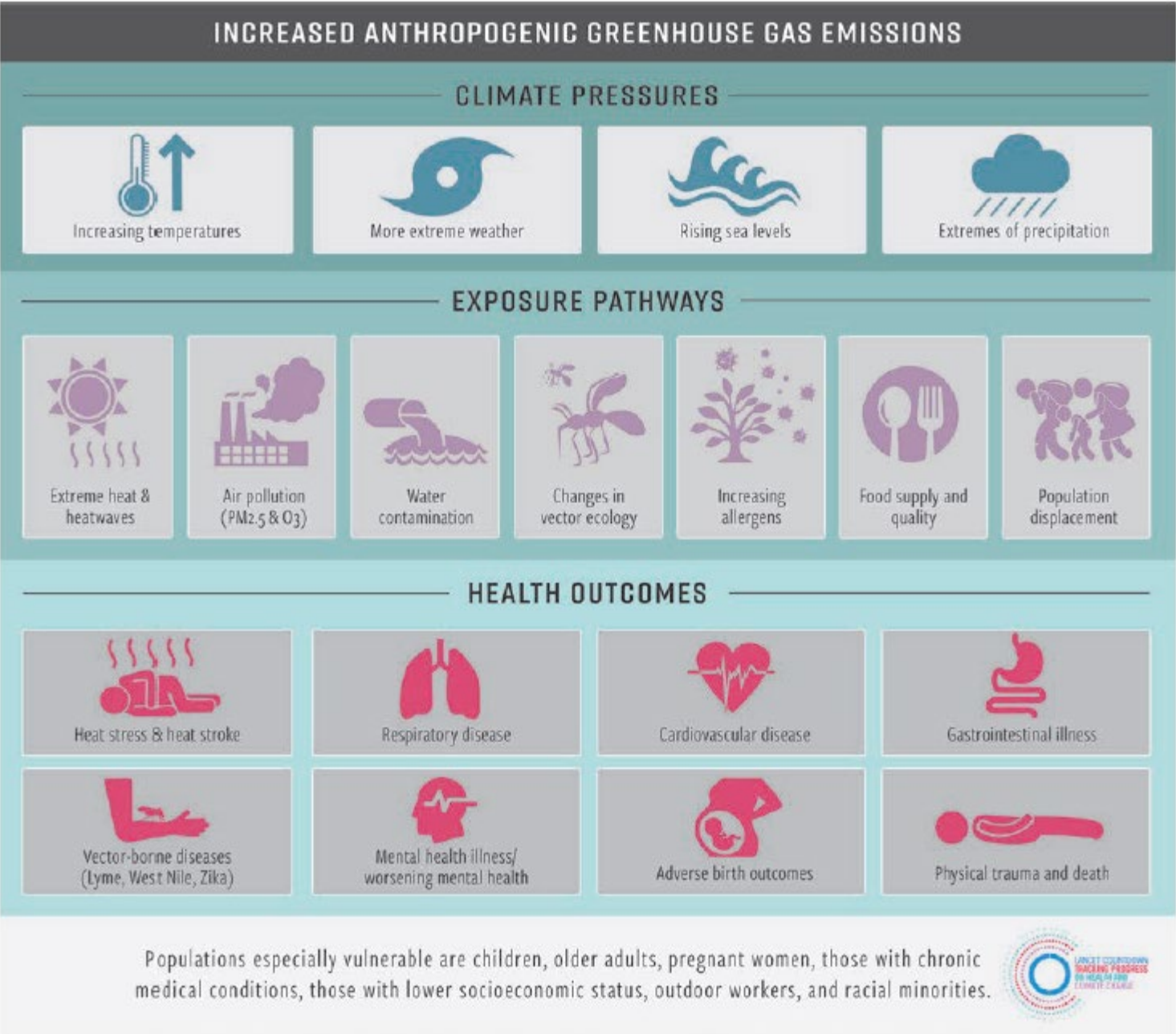


Figure created for Brief by M. Lee (Climate Nexus).

Figure 2: Extreme Heat is Harming the Health of Americans.

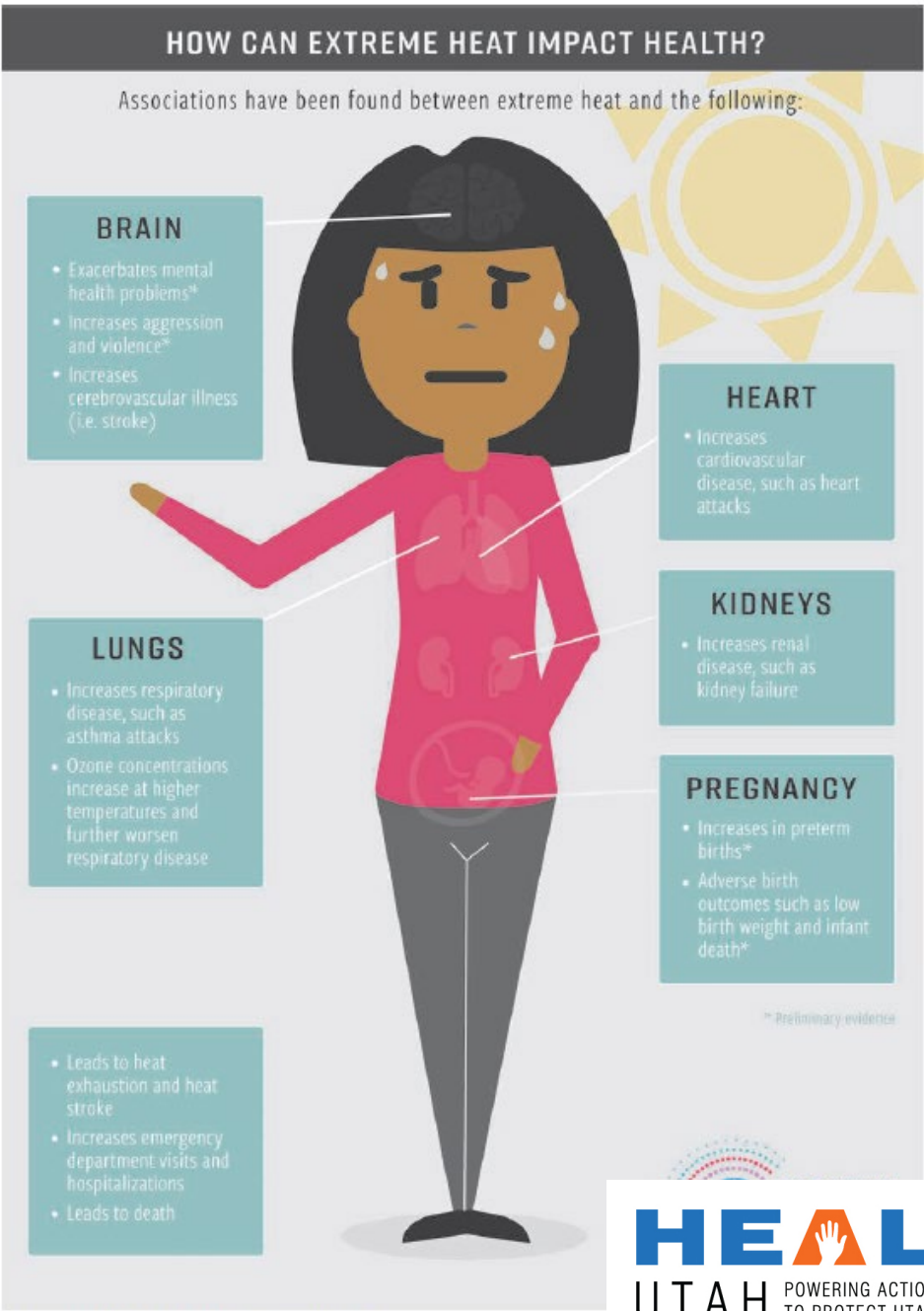


Figure created for Brief by M. Lee (Climate Nexus).

The Krebs Cycle of Climate Change Health Impacts

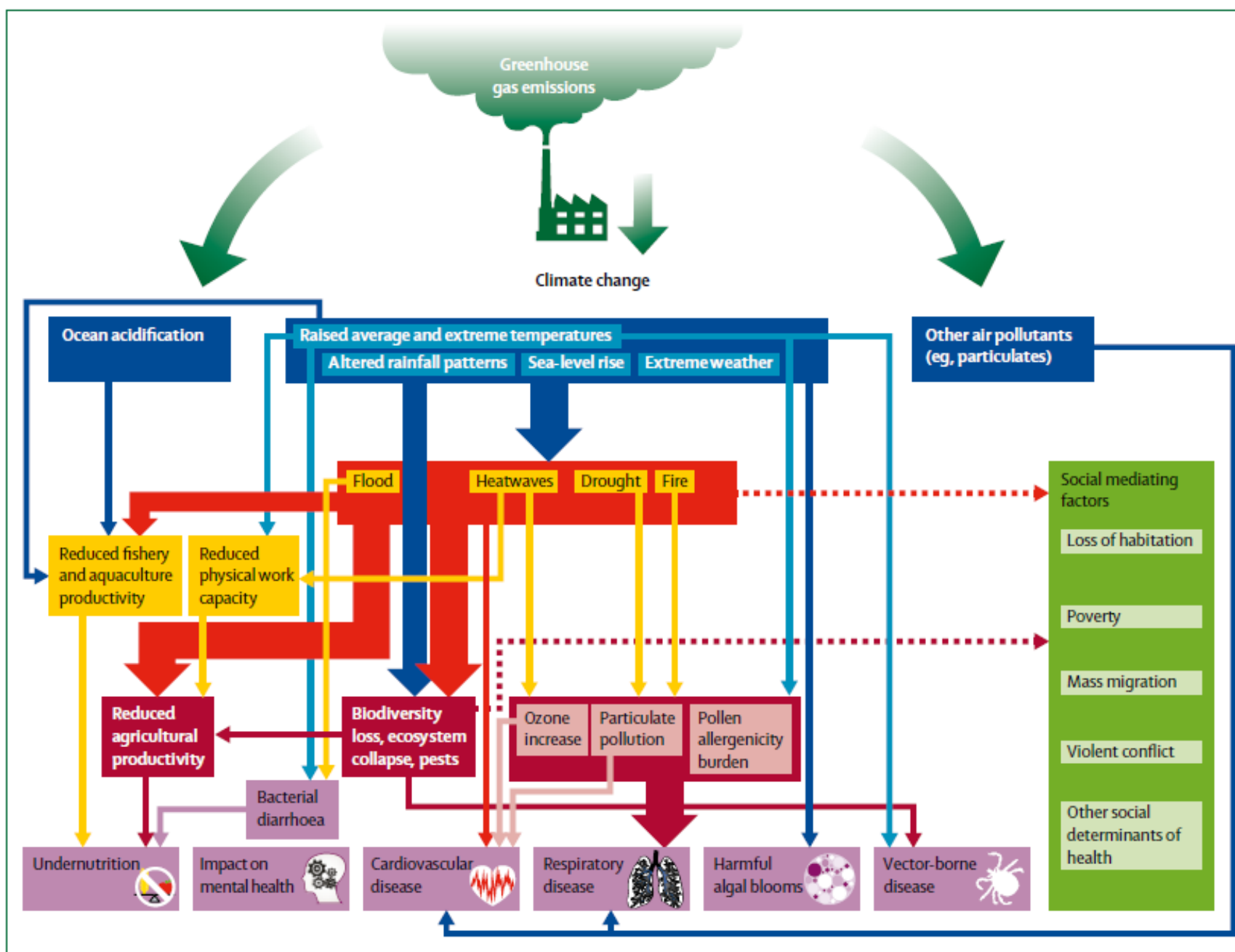


Figure 1: The pathways between climate change and human health

So the Scientific Consensus is that the
Planet has a Bad Disease
With a Bad Prognosis.

What Treatment(s) Might Be Effective?



First, though

Is This Scope of
Economic/Social/Political
Change Even Possible?

Environmental Policy Solution Success Stories

Case Study- Acid Rain

- The Problem: Several decades ago, sulfur dioxide from coal-fired power plants was creating harmful acid rain killing aquatic life and forests. Traditional regulation would have simply directed every plant owner to cut pollution by a specific amount in a specific way, an expensive and often ineffective solution.
- The Policy Solution: A cap-and-trade approach was written into the 1990 Clean Air Act. It required overall sulfur emissions be cut in half, but would let each company decide how to do it. Power plants that cut their pollution more than required could sell the extra allowances.
- The Results: Sulfur emissions went down faster than predicted and at one-fourth of the projected cost. Cap and trade was so effective and affordable that *The Economist* magazine called it the "greatest green success story of the decade."

Environmental Policy Solution Success Stories

Case Study- The Hole in the Ozone

- The Problem:
 - In 1985, scientists discovered a large area of thinning of the atmospheric ozone layer above Antarctica.
 - This blanket of ozone, or O₃, blocks most of the sun's high-frequency ultraviolet rays that can cause skin cancer and cataracts in humans, as well as reproductive problems in fish, crabs, frogs, and even in the single-celled phytoplankton at the bottom of the ocean food chain.
 - Chlorofluorocarbons (CFCs) released from refrigerants and aerosol sprays that persisted for decades in the atmosphere were generating free chlorine atoms that pulled ozone molecules apart.
 - Studies suggested that, without an intervention, the Earth's entire ozone layer would have collapsed by 2050, leading to 280 million extra cases of skin cancer as well as a spike in cataracts and other health problems

Environmental Policy Solution Success Stories

Case Study- The Hole in the Ozone

- The Policy Solution: the Montreal Protocol of 1987, a pact to phase out the use of CFCs and restore the ozone layer was eventually signed by every country in the United Nations—the first UN treaty to achieve universal ratification.
- The Results: The hole in the ozone is now the smallest it's been in 30 years. A complete rebound seems imminent. Some scientists project that by 2080 global ozone will return to 1950s levels.

Solution Lists

Environmental Defense Fund

- Limit Power Plant Pollution
- Prioritize China's Pollution Problem
- Expand Carbon Markets Worldwide
- Unleash Clean Energy in the U.S.
- End Fossil Fuel Subsidies
- Unlock the Profit of Living Rainforests
- Stop Methane Leaks
- Cut Deadly Soot
- Phase Out Super Polluting HFCs
- Reduce Fertilizer Pollution

Solutions Lists

Project Drawdown

Paul Hawkin
(Smith & Hawkin)

Research organization that reviews, analyses, and identifies the most viable global climate solutions

“Stopping global warming is possible, with solutions that exist today.”

Top 100 Prioritized Strategies

<https://www.drawdown.org/solutions>

Drawdown solution #1: Refrigerant Management



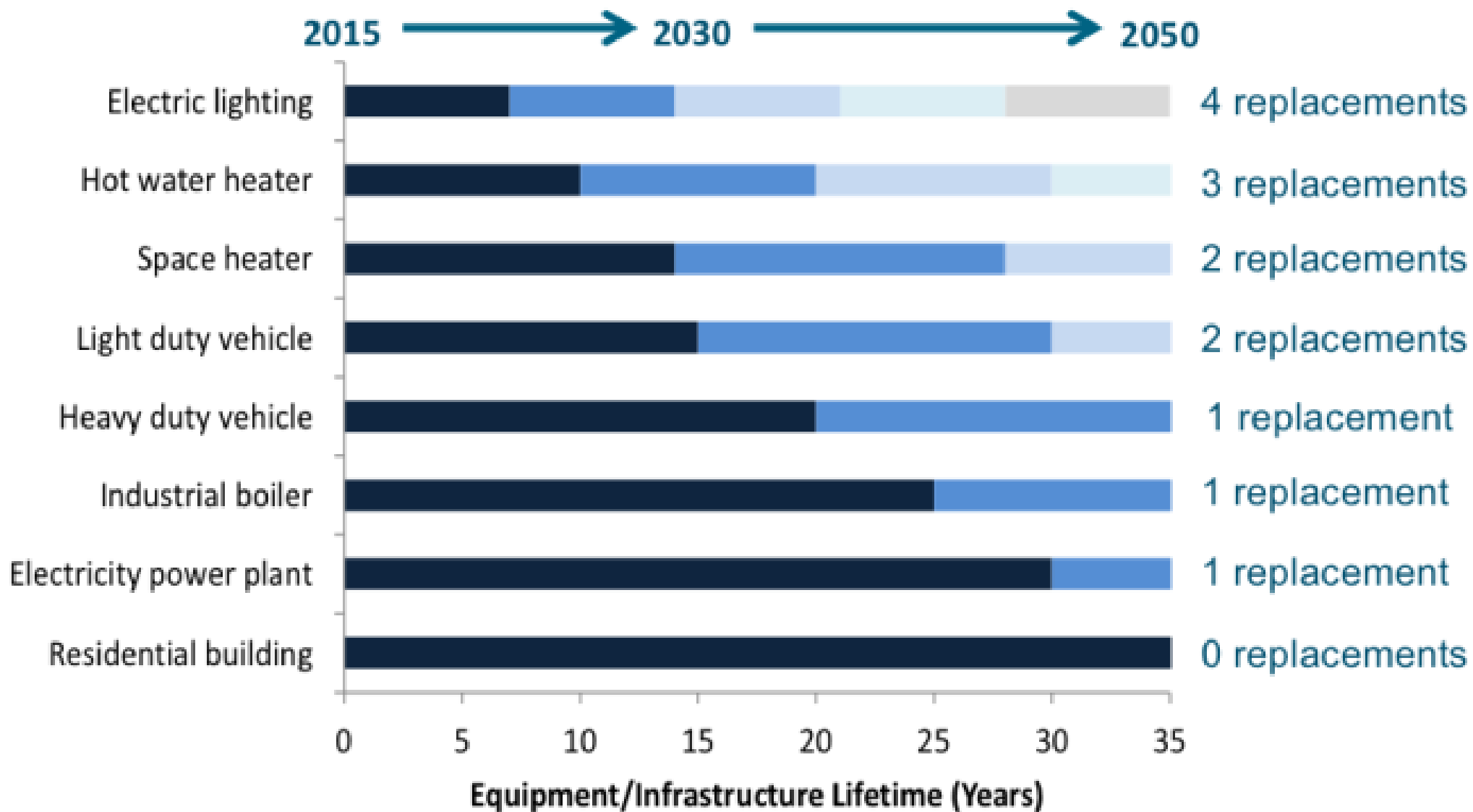
The Kilgali Amendment to the Montreal Protocol- phases out HFCs over the next 30 years.
Ratified by 72 countries- but not the United States ... not yet.

Solutions- Project Drawdown

<https://www.drawdown.org/solutions>

Solutions by Rank

Rank	Solution	Sector	TOTAL ATMOSPHERIC CO2-EQ REDUCTION (GT)	NET COST (BILLIONS US \$)	SAVINGS (BILLIONS US \$)
1	Refrigerant Management	Materials	89.74	N/A	\$-902.77
2	Wind Turbines (Onshore)	Electricity Generation	84.60	\$1,225.37	\$7,425.00
3	Reduced Food Waste	Food	70.53	N/A	N/A
4	Plant-Rich Diet	Food	66.11	N/A	N/A
5	Tropical Forests	Land Use	61.23	N/A	N/A
6	Educating Girls	Women and Girls	51.48	N/A	N/A
7	Family Planning	Women and Girls	51.48	N/A	N/A
8	Solar Farms	Electricity Generation	36.90	\$-80.60	\$5,023.84
9	Silvopasture	Food	31.19	\$41.59	\$699.37
10	Rooftop Solar	Electricity Generation	24.60	\$453.14	\$3,457.63



Pathways to Deep Decarbonization in the United States

<https://grist.org/climate-energy/yes-the-u-s-can-reduce-emissions-80-by-2050-in-six-graphs/>

Climate Change Lifestyle Solutions- Energy Star

Government-backed symbol for energy efficiency

<https://www.energystar.gov/>

- Overall program
 - 60,000 products with ES rating
 - 2800 products with “most efficient” rating
 - \$100 billion annual market
 - Products are related to 600,000 jobs
 - Consumer financial incentives
- 2017
 - 300m products + 300m light bulbs purchased
 - ↓ 130 million tons of greenhouse gases(GHG)
- Residential
 - Certified homes
 - 2 million since 1995
 - 1/10 new homes in 2018
 - 2017 = ↓ 3 million tons of GHG
 - Appliances, windows, insulation
- Commercial
 - ES Energy Portfolio Manager
 - 25% of all U.S. commercial properties
 - 2017 = ↓ 110 million tons of GHG
- Industrial
 - Bakeries, pharma plants, steel mills
 - 2017= ↓ 40 million tons of GHG

Climate Change Lifestyle Solutions- Automobile Ratings

- Greenhouse Gas (GHG) ratings
 - CO₂ (90%)
 - Methane
 - NO_x
 - Hydrofluorocarbons
- Smog ratings
 - Volatile organic compounds (VOCs)
 - NO_x
 - CO
 - Particulates
 - Formaldehyde



<https://www.epa.gov/greenvehicles/greenhouse-gas-rating>

Solutions/Personal/Vehicles- Automobile GHG ratings

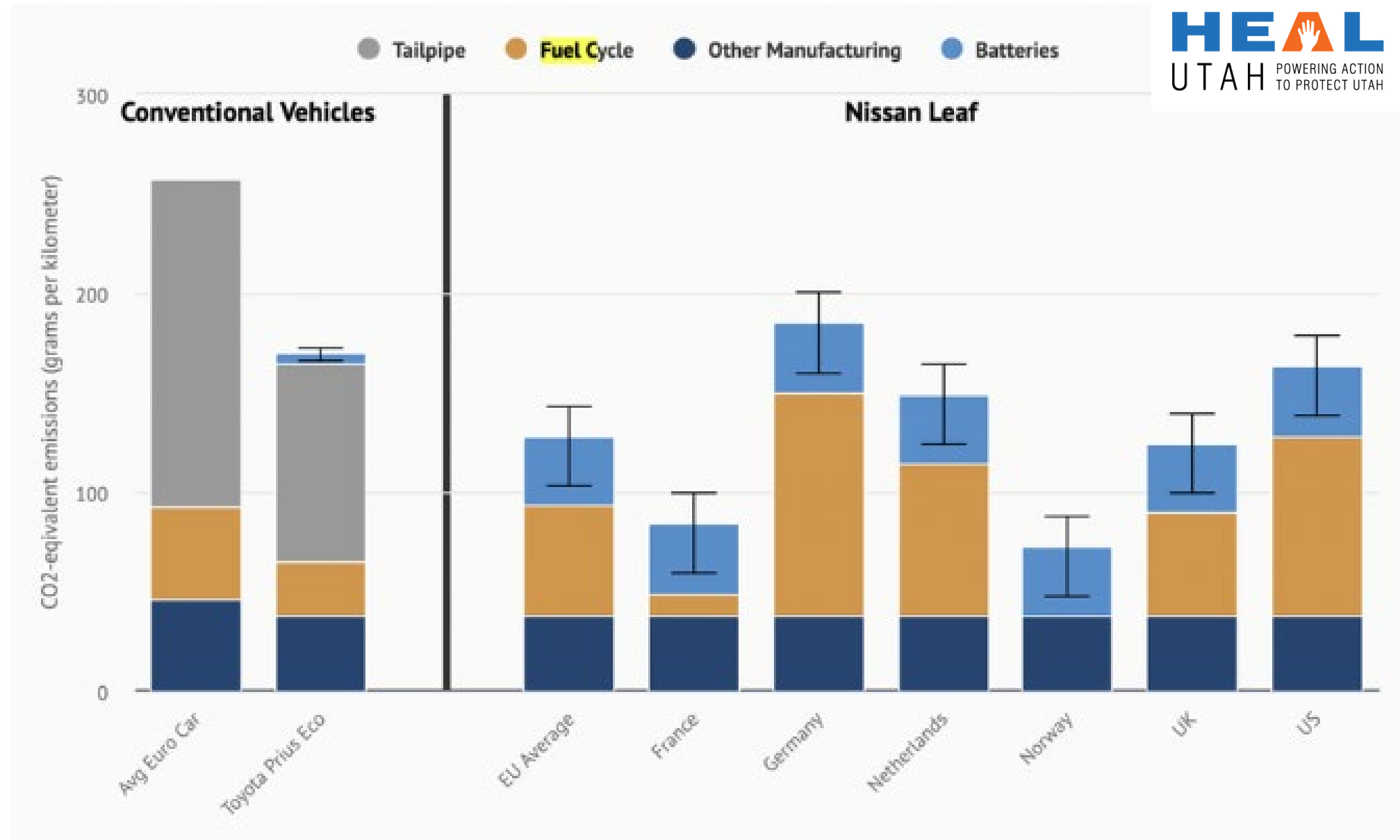
<https://greencars.org/greenest-meanest/greenest>

Rating	MPG (gas)	CO ₂ (g/mile)
10	>=44	0-204
9	38-43	205-237
8	33-37	238-273
7	30-32	274-301
6	27-29	302-335
5	23-26	336-395
4	20-22	396-456
3	17-19	457-539
2	15-16	540-613
1	<=14	>=614

Make and model	Specifications	MPG cityb,c	MPG hwyb,c	Green Score
Mercedes-Benz smart EQ fortwo Coupe	Electric (Li-Ion)	3.8	2.9	68
Hyundai Ioniq Electric	Electric (Li-Ion)	4.7	3.8	67
Toyota Prius Primed	Electric (Li-Ion) / 1.8L 4, auto CVT	4.3 / 55	3.6 / 54	65
Hyundai Ioniq Blue	1.6L 4, auto	57	59	65
BMW i32	Electric (Li-Ion)	3.7	3.0	65
Toyota Prius Eco	1.8L 4, auto CVT	58	53	64
Honda Clarity Electric	Electric (Li-Ion)	3.7	3.1	64
Kia Soul Electric	Electric (Li-Ion)	3.7	2.8	63
Nissan Leaf	Electric (Li-Ion)	3.7	3.0	63
Honda Insight	1.5L 4, auto CVT	55	49	63
Hyundai Kona Electric	Electric (Li-Ion)	4.1	3.2	63
Volkswagen e-Golf	Electric (Li-Ion)	3.7	3.3	62
Toyota Camry Hybrid LE	2.5L 4, auto CVT	51	53	62

Are Electric Vehicles Really Better For The Environment?

<https://www.forbes.com/sites/jamesellsmoor/2019/05/20/are-electric-vehicles-really-better-for-the-environment/#5d3f254d76d2>



A report by Carbon Brief shows that across Europe and the United States, electric vehicles contribute less to climate change than conventional vehicles. [-] CARBON BRIEF

Solutions- Physician Influence

Office/ Hospital Operations

- Energy Efficiency
- Renewable Energy
- Water Efficiency
- Solid Waste & Recycling
- Drug Disposal & Chemicals
- Transportation & Commuting
- Healthy Foods

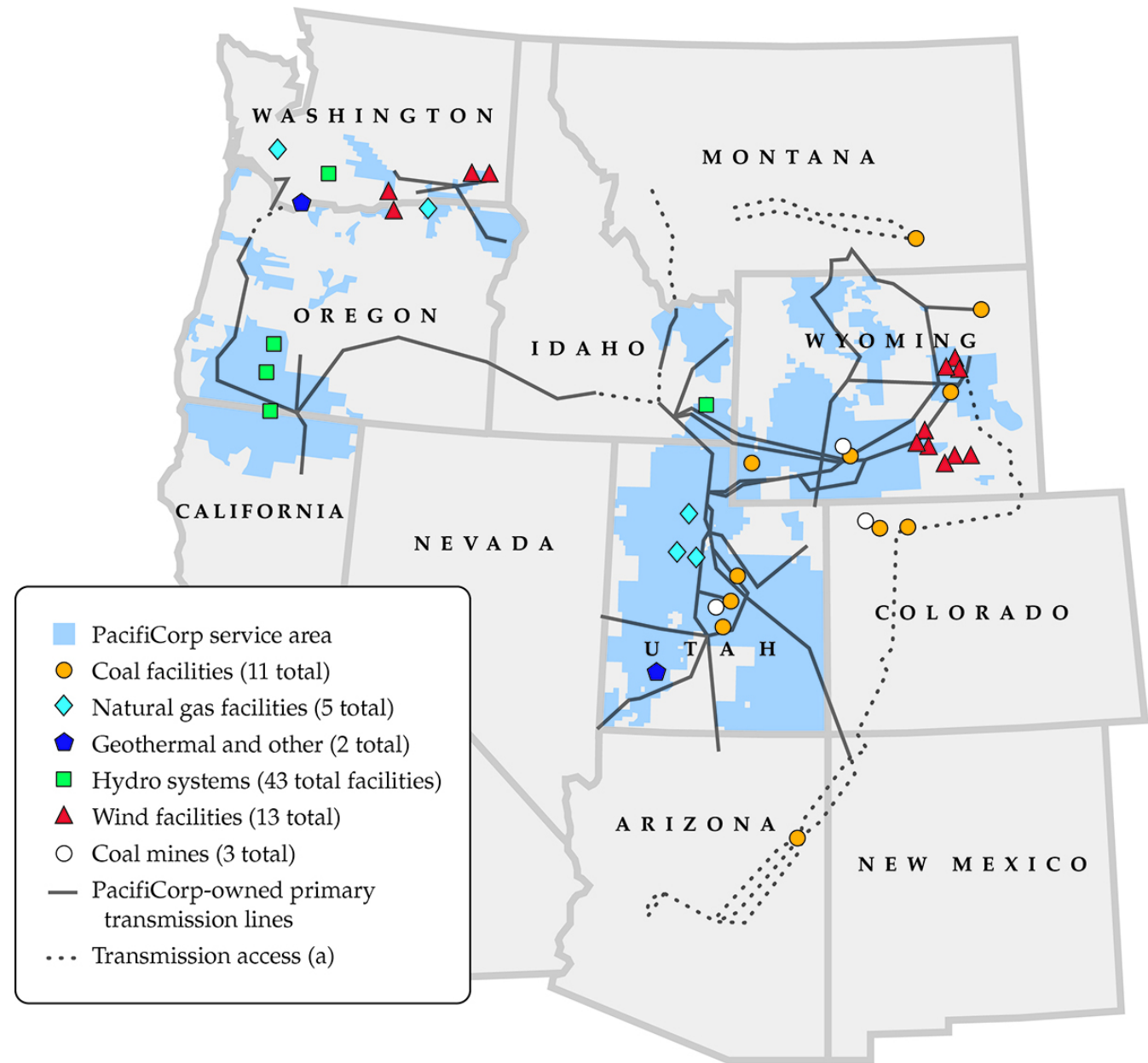
<https://www.mygreendoctor.org>

Patient Education

- Incorporate into patient visits
 - Relate to patient's situation
 - Posters, Brochures, Fact Sheets
- [American College of Physicians Fact Sheet](#)
- Colleagues
 - Presentations
 - Informal Conversations
- Family & Friends

Rocky Mountain Power/ PacifiCorp Energy Sources

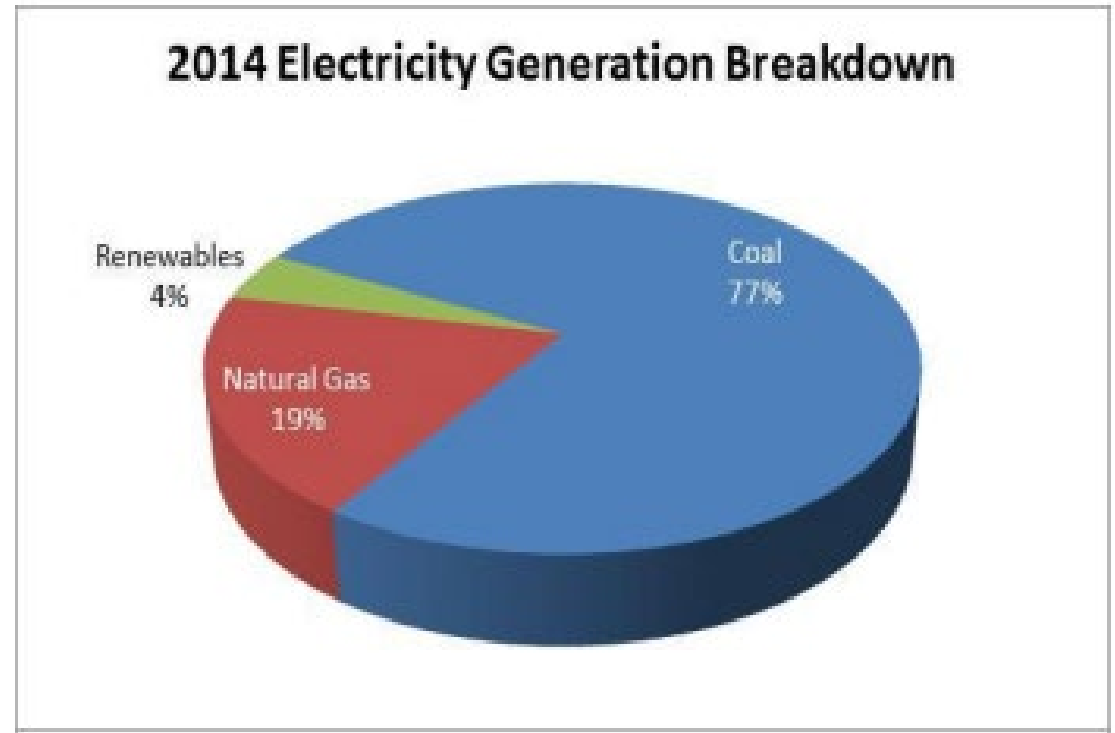
- 56.39% coal
- 15.44% natural gas
- 8.80% wind
- 5.15% hydro
- 3.79% solar
- 0.39% geothermal
- 0.34% biomass
- 9.75% miscellaneous



Rocky Mountain Power/ PacifiCorp Energy Sources

- 2019 Integrated Resources Plan
- 20 year plan
- Updated every 2 years
- Announced the intended closure of 83% of its coal units by 2038
- Oregon, Washington, and California plan to stop paying for coal by 2025
- RMP could shift coal costs to Utah rate-payers and renewable costs to other states.

Utah



Municipalities with 100% Renewable Goals

Across the US

- 9 States
- 11 Counties
- 141 Cities & Towns
 - 6 towns are already at 100%
- Various target dates
- Various phase-in strategies
- 1 in 5 or 70 million people

Utah

- Salt Lake City (2032)
- Park City (2032)
- Summit County (2032)
- Cottonwood Heights (2032)
- Holladay (2030)
- Moab (2032)

HB 411- 2019 Utah Leg Session

<https://www.sierraclub.org/ready-for-100/commitments>

2018 Utah Legislature- H.C.R. 7

Concurrent Resolution on Environmental and Economic Stewardship

- Initiated by students from Logan late in the 2017 session
- Sponsored in 2018 by Rep. Becky Edwards and Sen. Todd Weiler
 - recognizes the need for responsible stewardship and prudent management of natural resources;
 - recognizes the impacts of a changing climate on Utah citizens;
 - expresses commitment to create and support economically viable and broadly supported solutions, including in rural communities;
 - encourages the use and analysis of sound science to understand the causes and impacts of local and regional climates;
 - encourages resilient ecosystems that can better adapt to our changing environment; and
 - encourages the reduction of emissions through incentives and the support of growth in technologies and services that enlarge the economy.
- Passed the House 51/21/3
- Passed the Senate 23/3/3
- <https://le.utah.gov/~2018/bills/static/HCR007.html>

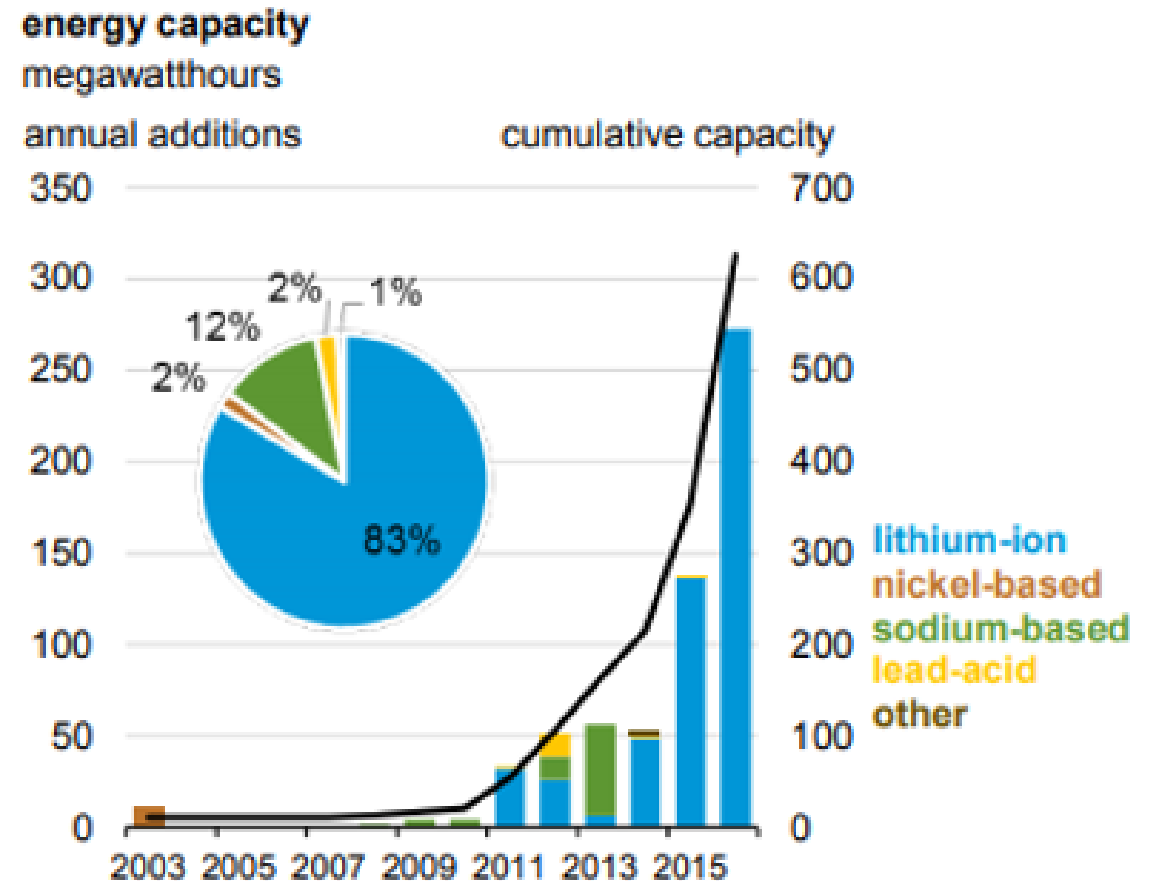
2020 Utah Legislature- Securitization

- Rocky Mountain Power is disincentivized to close coal plants
 - Paying down long-term debt
 - Paid off through consumer utility rates
 - ROI is based on keeping plants open through their initial useful life projection
 - Operating them longer increases RMPs ROI
- Closing coal plants early creates “stranded assets”
- Can be turned into recycled capital using securitization
 - RMP “securitizes” the stranded asset by issuing a bond to investors
 - AAA rated bond, guaranteed return due to ratepayer obligation
 - Freed up capital is recycled into the development of large, renewable energy sources
 - Lower interest rate, lower operating costs,
 - Emissions reduced, consumer utility rates don’t increase, share prices remain stable, additional funds for community transition

Energy Storage- Utility Scale

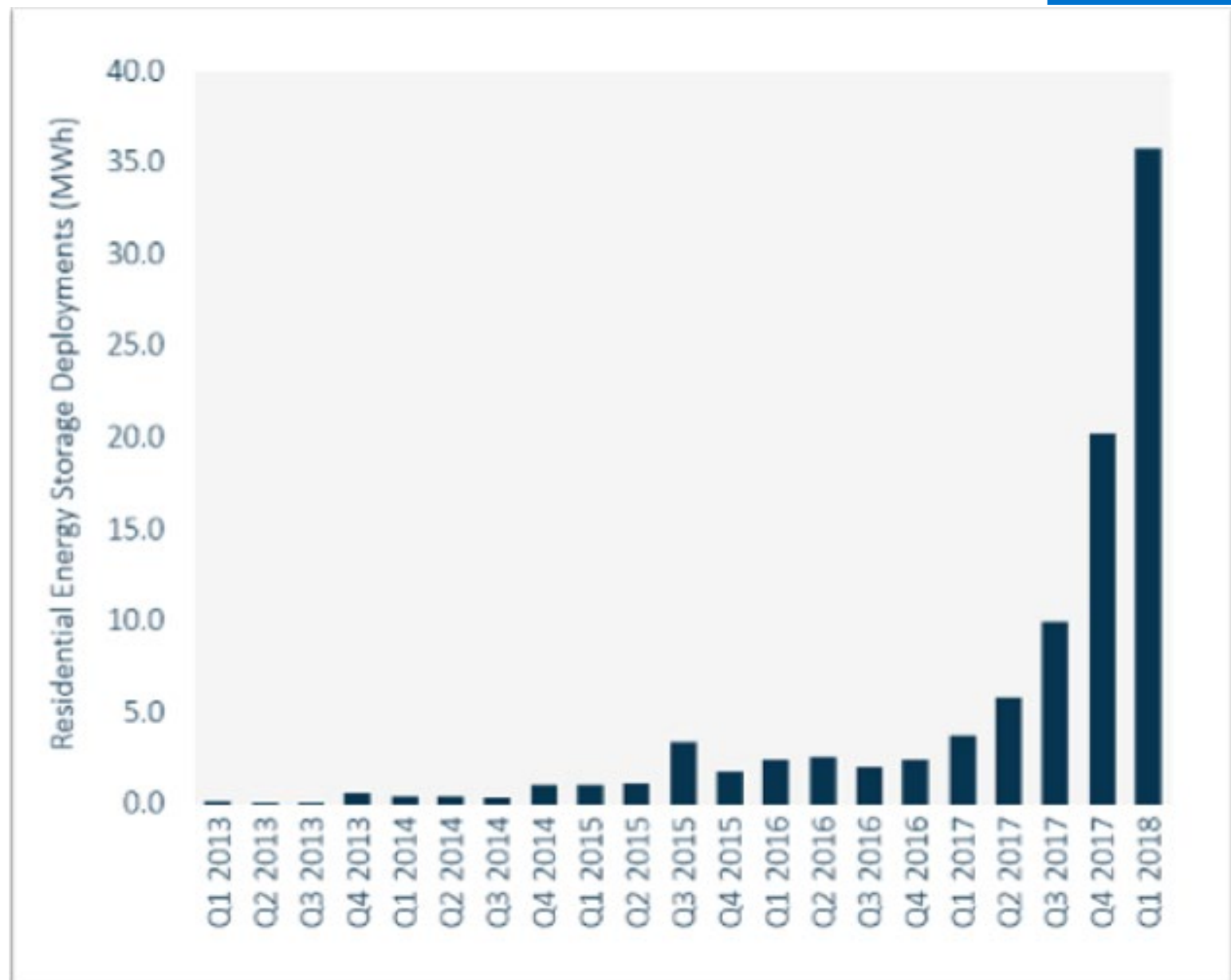
- Compressed Air Energy Storage
- Flywheels
- Flow Batteries
- Pumped Hydro Power
- Thermal
- Solid-State Batteries ----->

https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf



Energy Storage- Residential Scale

<https://www.greentechmedia.com/articles/read/led-by-surging-residential-sector-q2-us-energy-storage-deployments-grow-200#gs.plbIFbM>



Nuclear Power is NOT a necessary component of the solution climate change

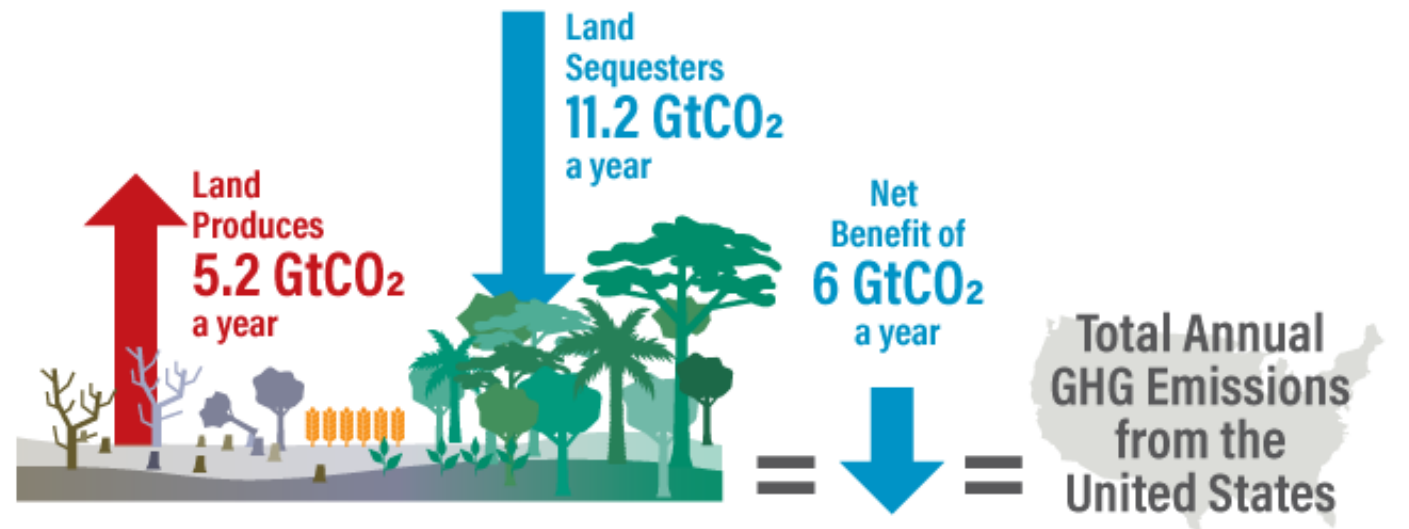
- Long lag time from planning to operations
 - 10-20 years vs. 4-7 for wind and solar
- Cost
 - 5 times more per Kw than on-shore wind
- Weapons Proliferation Risk
- Meltdown Risk
- Mining Lung Cancer Risk
- Carbon-Equivalent Emissions
- “Baseload” reliability
 - natural gas, hydropower, or batteries ramp up 5 to 100 times faster



Land Use Solutions

- Tropical Forests
- Cover Crops
- Grazing
- Desertification
- Fugitive Dust
- Fertilizer
- Food Waste
- Active management

Land is Both a Powerful Sink and Emitter of Carbon Dioxide Emissions



Note: Values are an average over 2007–2016

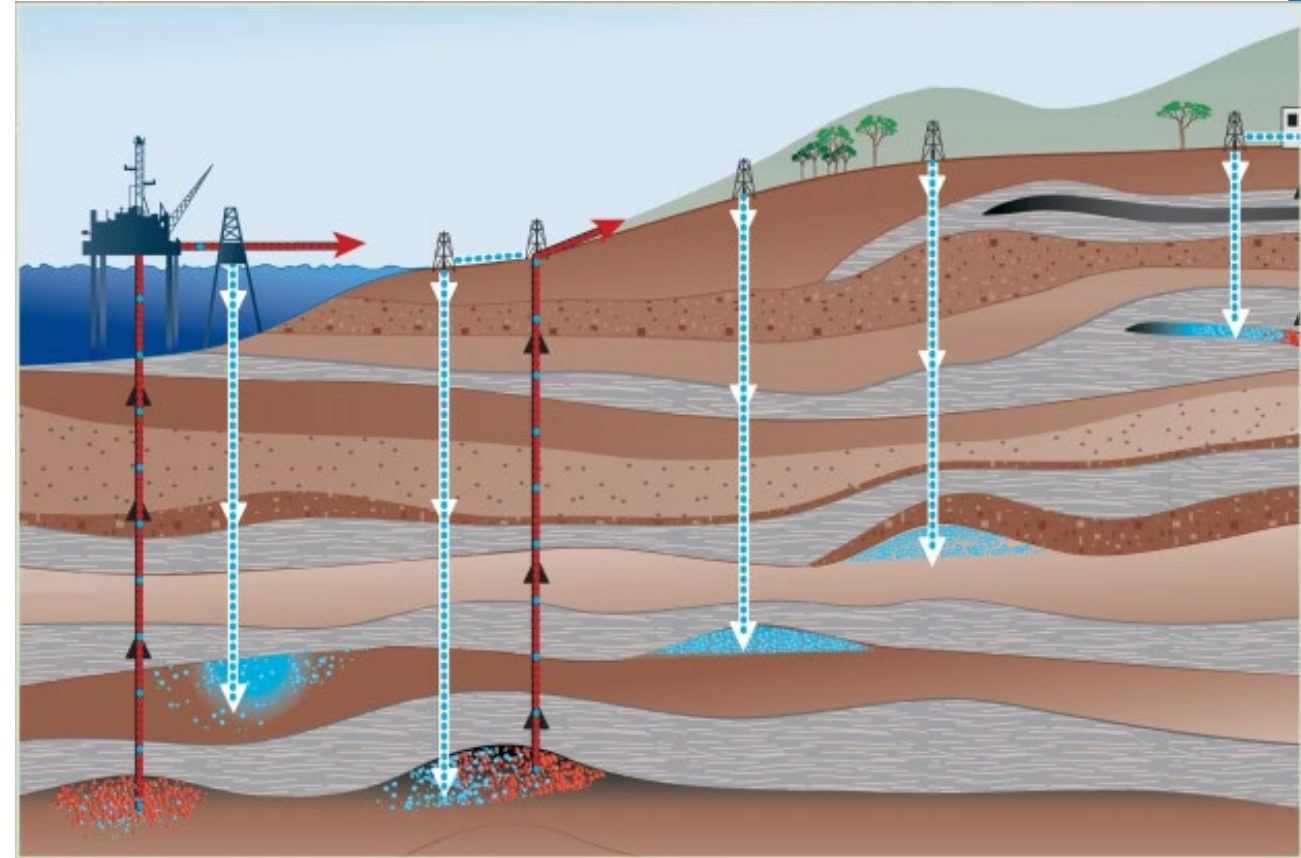
Source: IPCC Special Report on Climate Change and Land



WORLD RESOURCES INSTITUTE

Carbon Capture and Storage (CCS)

- Captured from emission source
 - absorption with amines
 - adsorption
 - membrane gas
- Transport
 - Pipeline
 - Ships
- Storage
 - Deep geologic- gas
 - Biologic metabolism
 - Algae or bacteria
 - Mineral conversion- solid
 - Reacts with metal oxides to form stable carbonates
- Promoted by fossil fuel industry
- Normal innovation curve
 - low cost in 2077
 - widespread adoption by 2100



Energy Innovation and Carbon Dividend Act

HR 763- Rep. Deutch (R-Florida) & 68 co-sponsors

- Places a steadily rising fee on carbon emissions
 - Starts at \$15/metric ton, increases by \$10/metric ton each year
 - Assessed as close to the source as possible- mine, refinery, first pipeline, port
- Gives 100% of the fees minus administrative costs back to households each month.
 - Average dividend for a family of 4 = \$3500/year
- Uses a border adjustment to levelize trade and discourage business relocation.
- Pauses the EPA authority to regulate the CO2 and equivalent emissions covered by the fee for the first 10 years after the policy is enacted.
 - Auto mileage standards regulation would continue.

Energy Innovation and Carbon Dividend Act HR 763

- Reduces carbon emissions by 40% over the first 12 years.
- Creates 2.1 million new jobs
- 350,000 pollution-related deaths prevented
- Supported by 3500 economists
- Bipartisan

<https://citizensclimatelobby.org/basics-carbon-fee-dividend/>

<https://energyinnovationact.org/how-it-works/>

- Climate Leadership Council- Baker/Shultz version

<https://www.clcouncil.org/our-plan/>

<https://insideclimatenews.org/news/07032019/carbon-tax-proposals-compare-baker-shultz-exxon-conocophillips-congress>

Mitt Romney/ Pierre Dilecto

- Focused on climate change while Governor of Massachusetts from 2003-2007.
- Then downplayed/reversed his “position” initially as presidential candidate.
- Has once again repeatedly made public statements since as early as 2012 that “climate change is real and humans are contributing to it”.
- Has indicated that he is open to a carbon tax.
- Believes that India and China are the key to a real solution.
- Is one of three Republicans in the bi-partisan Senate climate caucus.

Questions or Comments?

SIX Pillars

GREEN SYNTHETIC FUELS.

Deployment of a wide range of potential synthetic fuels, including hydrogen, synthetic methane, synthetic methanol, and synthetic liquid hydrocarbons applicable for harder to abate sectors.

ELECTRIFICATION OF END USES.

The penetration of electricity, built on existing technologies, can enable a green conversion for the sectors currently using fossil-fuel energy.

ZERO-CARBON ELECTRICITY.

A shift towards zero-carbon electricity mix.

SUSTAINABLE LAND-USE.

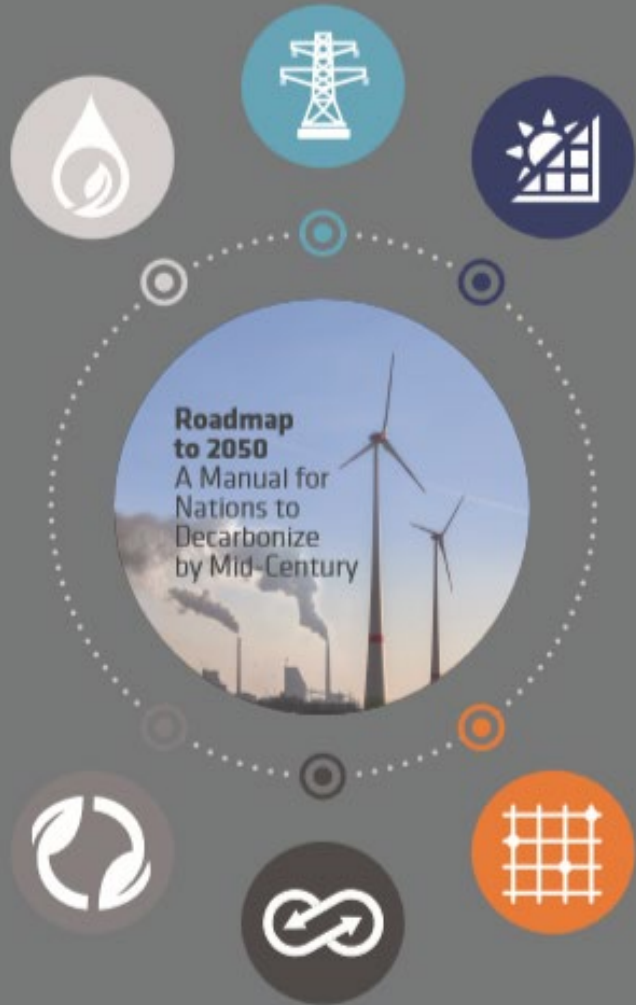
Mainly involving the agriculture sector, as it contributes up to a quarter of all greenhouse gas emissions from deforestation, industrial fertilizers, livestock, and direct and indirect fossil-fuel uses.

MATERIALS EFFICIENCY.

Improved material choices and material flows, such as reduce, reuse, and recycle to significantly improve materials efficiency.

SMART POWER GRIDS.

Systems able to shift among multiple sources of power generation and various end uses to provide efficient, reliable and low-cost systems operations, despite the variability of renewable energy.



United Nations Sustainable Development Solutions Network








<https://resources.unsdsn.org/roadmap-to-2050-a-manual-for-nations-to-decarbonize-by-mid-century>

Project Drawdown

<https://www.drawdown.org/solutions>

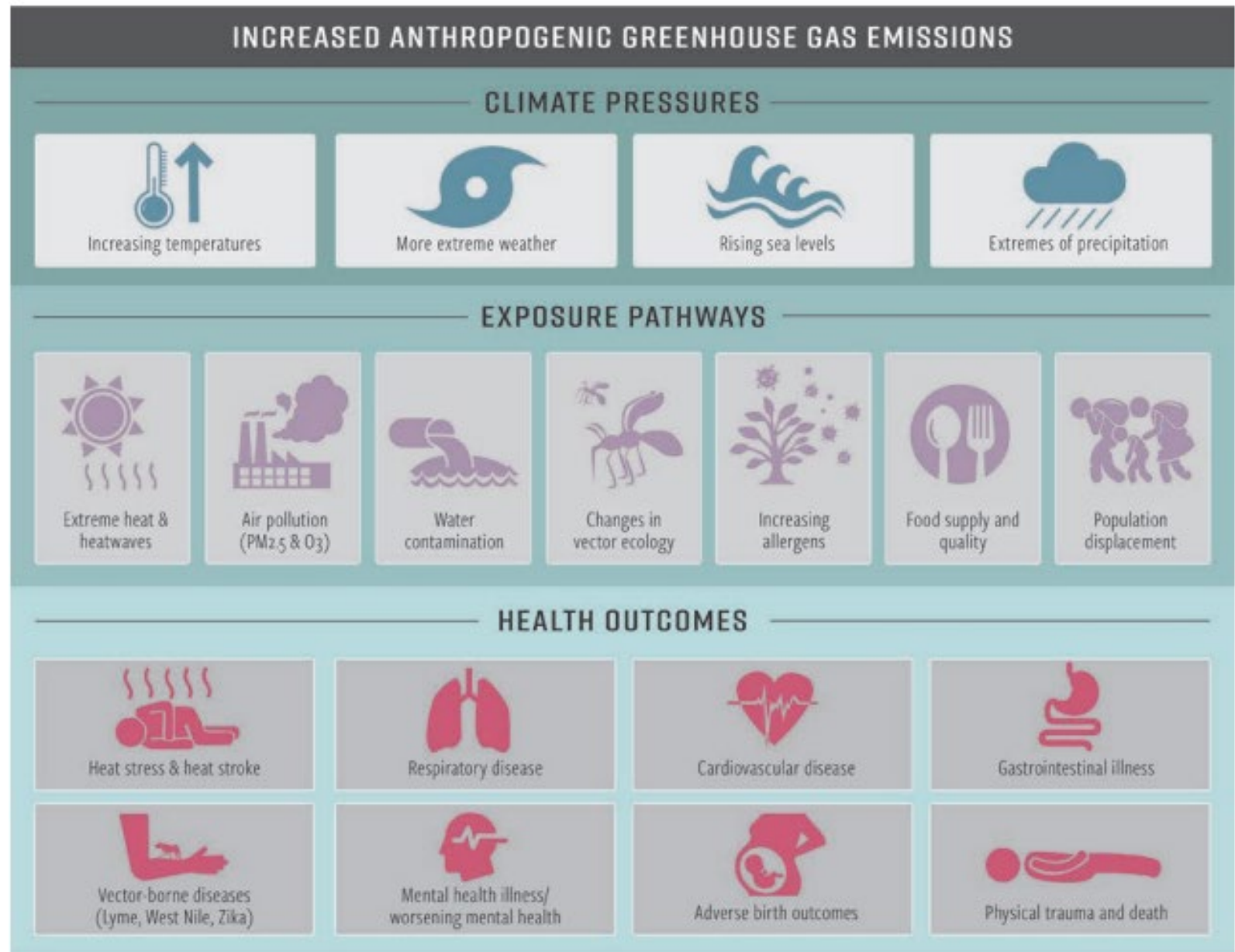
- Data collection
- -> Modeling
 - Against a reference case that assumes little change over the next thirty years
- -> 80 Ranked Solutions
 - Deployable
 - Economically viable
 - Scalable
 - “No Regrets”- make sense to take regardless of their climate impact since they have intrinsic benefits to communities and economies.
 - improve lives
 - create jobs
 - restore the environment
 - enhance security
 - generate resilience
 - advance human health
- Scenarios
 - **Plausible Scenario:** *the case in which solutions on the Drawdown list are adopted at a realistically vigorous rate over the time period under investigation, adjusting for estimated economic and population growth.*
 - **Drawdown Scenario:** *the case in which the adoption of solutions is optimized to achieve drawdown by 2050.*
 - **Optimum Scenario:** *the case in which solutions achieve their maximum potential, fully replacing conventional technologies and practices within a limited, competitive market.*

Health Impacts of Climate Change

	Climate Driver	Exposure	Health Outcome	Impact
 Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
 Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
 Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
 Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
 Water-Related Infection (<i>Vibrio vulnificus</i>)	Rising sea surface temperature, changes in precipitation and runoff affecting coastal salinity	Recreational water or shellfish contaminated with <i>Vibrio vulnificus</i>	<i>Vibrio vulnificus</i> induced diarrhea & intestinal illness, wound and blood-stream infections, death	Increases in water temperatures will alter timing and location of <i>Vibrio vulnificus</i> growth, increasing exposure and risk of water-borne illness.
 Food-Related Infection (<i>Salmonella</i>)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of <i>Salmonella</i> exposure	<i>Salmonella</i> infection, gastrointestinal outbreaks	Rising temperatures increase <i>Salmonella</i> prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
 Mental Health and Well-Being	Climate change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

Health Impacts of Climate Change

https://apha.org/-/media/files/pdf/topics/climate/2018_us_lancet_countdown_brief.ashx?la=en&hash=99279F373B9F005C9EC364AB02EB7F636F1380CF

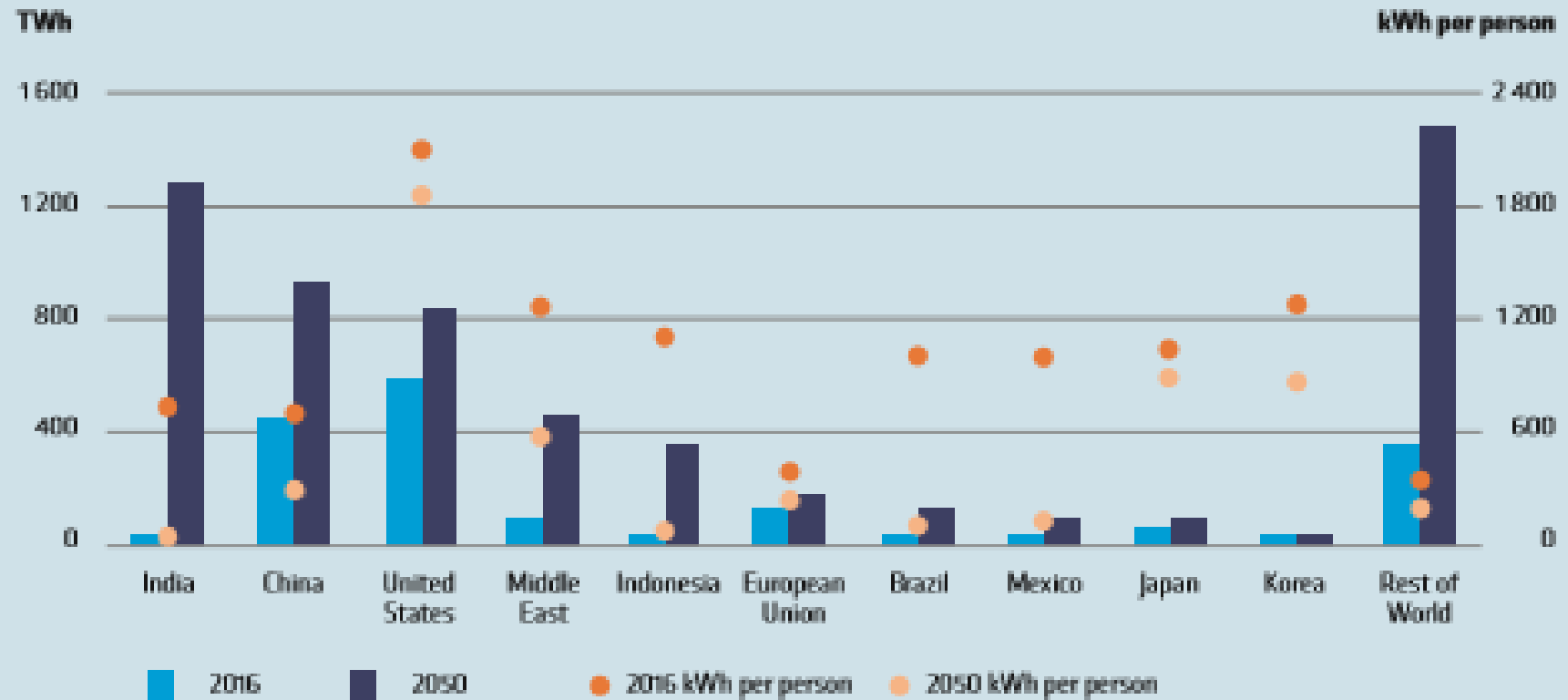


Populations especially vulnerable are children, older adults, pregnant women, those with chronic medical conditions, those with lower socioeconomic status, outdoor workers, and racial minorities.



Refrigerant management

FIGURE 10. World Air Conditioning Energy Consumption Growth⁶³



TOP 20 COMPANIES 1965-2017, CUMULATIVE

HOW TO READ



This cumulative total for Saudi Aramco is comparable to the annual emissions of six modern-day Chinas.

