

Meeting the Challenge of Climate Change

Solutions to the threat of rapid climate change:
can they be both fair and effective?

In two parts.



Citizens' Climate Lobby
<https://CitizensClimateLobby.org/>

John L Keller, PhD, CCM
wxchief@gmail.com
CCL Boston Metro West Chapter

Presentation to
Winchester Unitarian Society
2021.01.28



Meeting the Challenge of Climate Change

My background: early work in global atmospheric circulation



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letters to nature
Nature 248, 212 - 213 (15 March 1974); doi:10.1038/248212a0

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Strong long-period tropospheric and stratospheric rhythm in the Southern Hemisphere

PETER J. WEBSTER[†] & JOHN L. KELLER

Department of Meteorology, University of California, Los Angeles, Los Angeles, California 90024
[†]Present address: Department of Atmospheric Sciences, University of Washington, Seattle, Washington 98105

THE recent EOLE satellite-balloon atmospheric sensing experiment conducted in the Southern Hemisphere between August 1971 and July 1972, provided large quantities of upper tropospheric data in a hitherto near-dataless region. Besides measurements of ambient temperature and pressure reported directly from the balloon to the satellite, the experiment allowed the calculation of series of highly accurate Lagrangian velocities by the positioning of the balloon between successive satellite orbits. The experiment and data are described in detail by Morel and Bandeen¹.

Pieces of the climate system puzzle were still being discovered and clarified!

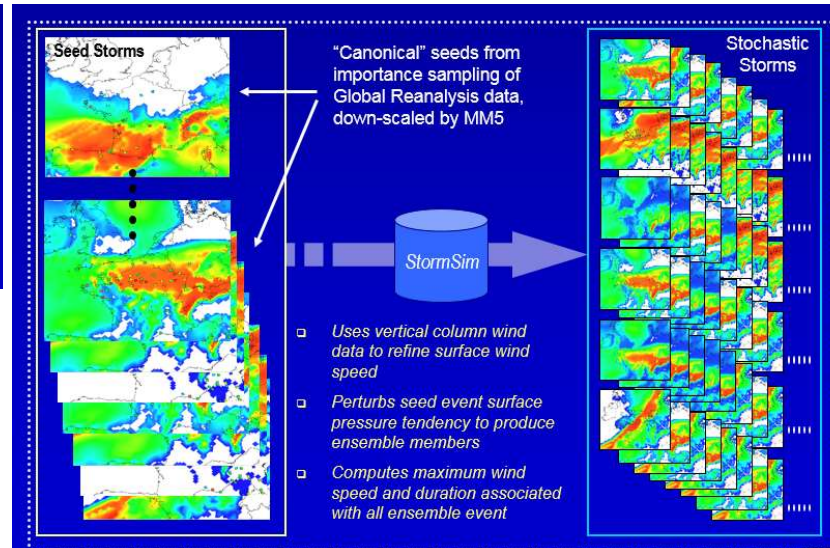
Meeting the Challenge of Climate Change

My background: general circulation (climate) model applications



A Statistical-Dynamical Model of the Storm-Wind Climate of Northwestern Europe

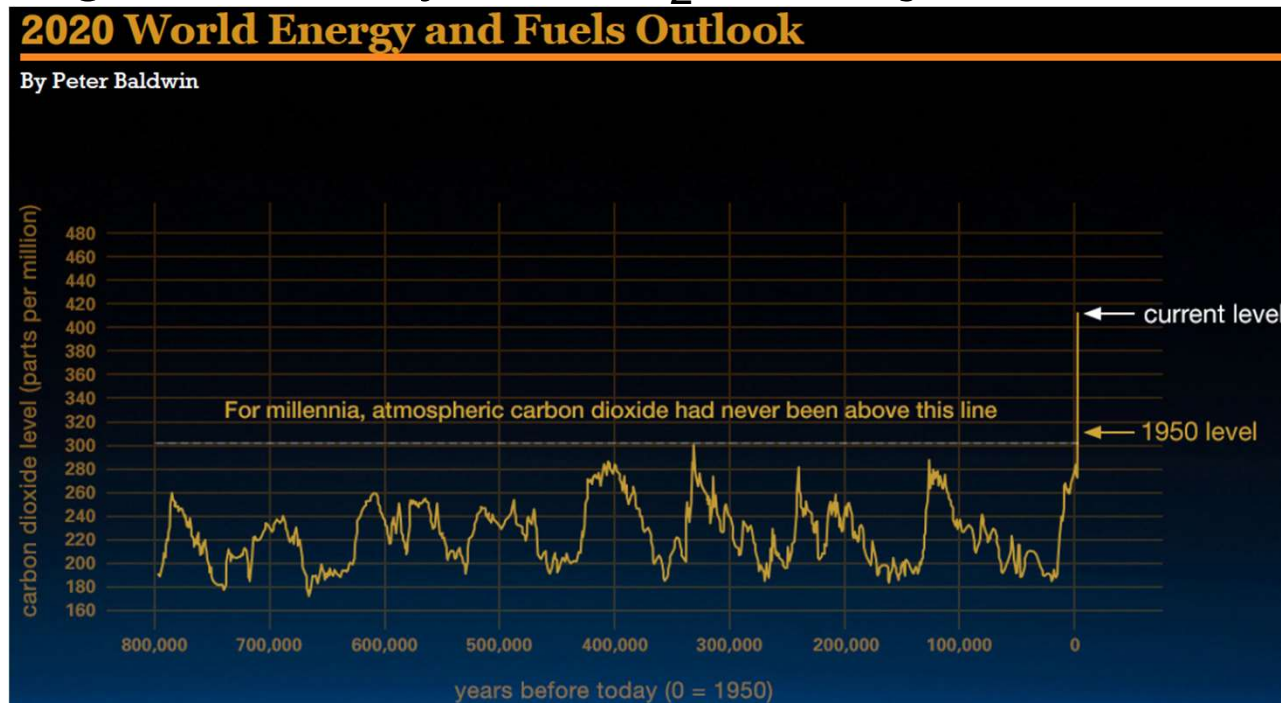
EGS-AGU-EUG Joint Assembly
Nice, France
10 April 2003
John L. Keller, Peter S. Dailey and Michele D. Fischer



Managing climate risk with AIR Worldwide’s EuroCAT system

Climate Change is Linked to Global Heating

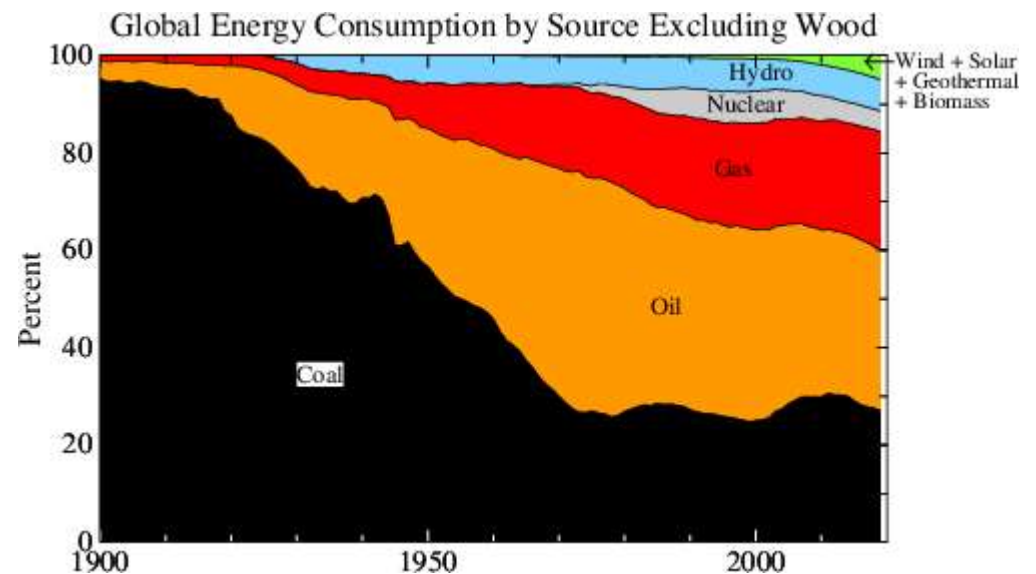
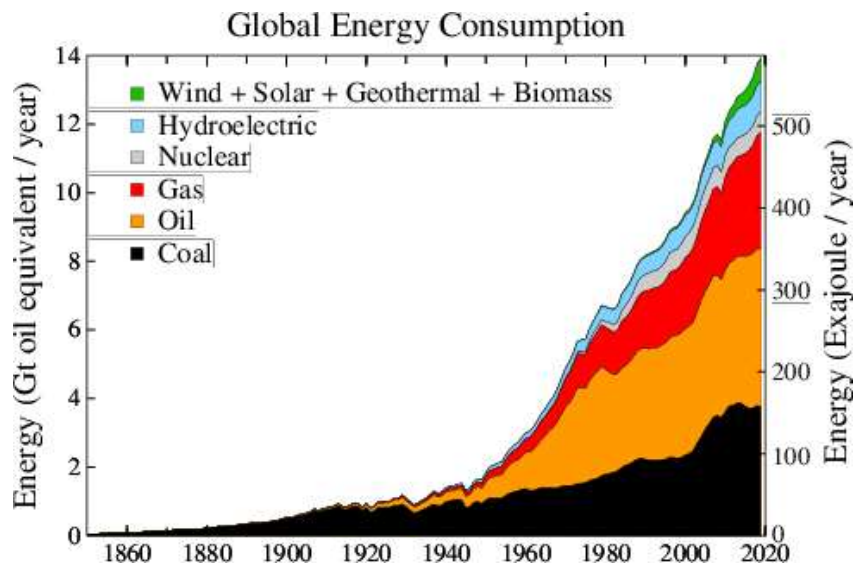
Global heating is driven by the CO₂ *already* in the atmosphere



...but ***faster*** CO₂ emission rates mean ***faster climate change***

An Explosion of Fossil Energy Use

What is the magnitude of the challenge globally?



Wind and solar make up about 5% of primary energy sources

How Much Will a Energy Transition Cost?

“Net-zero” **global** energy system

- \$1 T - \$2 T per year: to reach net-zero emissions by 2050
- \$ 250 B: Investments in renewable systems in 2019
- \$ 500 B: Invested in fossil energy extraction in 2019 (\$2.7 T since 2016)

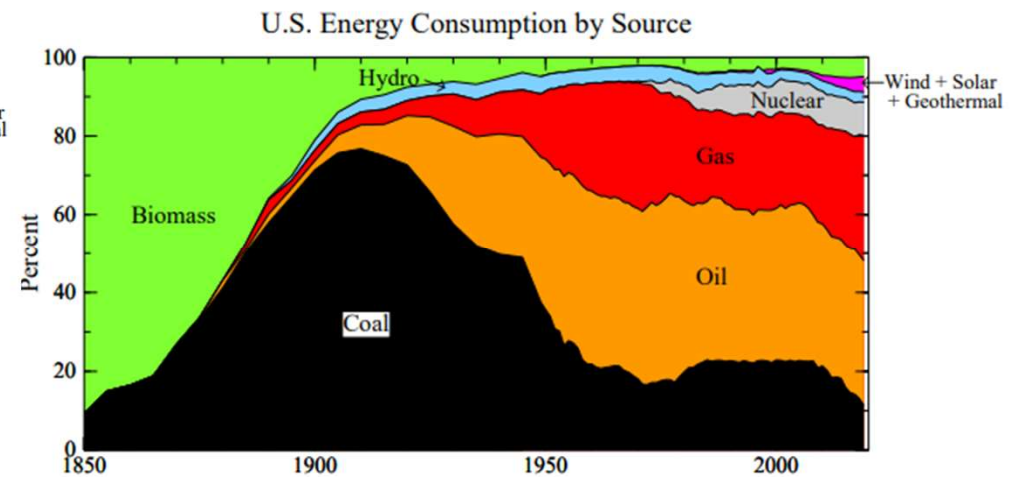
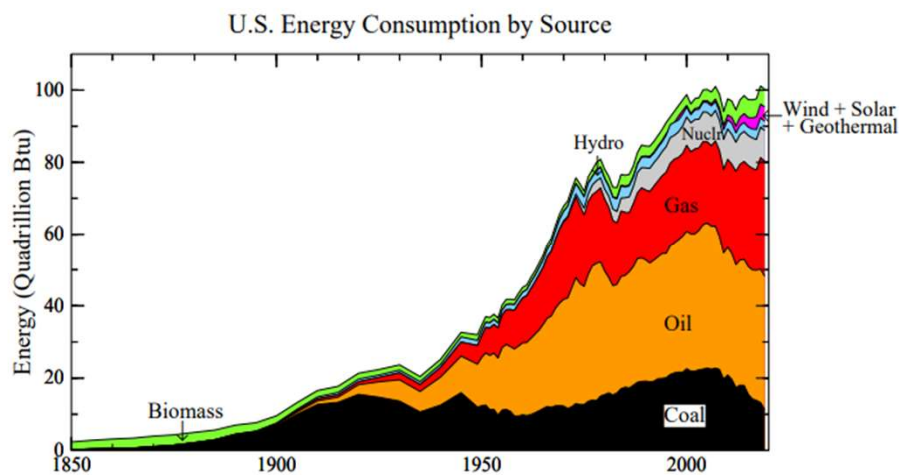
Must include systems integration for both demand side (conservation) and supply side

Global net zero transition estimate: Energy Transitions Commission and International Renewable Energy Agency

Who will pay to extend net-zero to the developing world?

An Explosion of Fossil Energy Use

What is the magnitude of the challenge in the U.S.?



Wind and solar make up about 5% of primary energy sources

How Much Will a Energy Transition Cost?

“Net-zero” **U.S.** energy system

- \$17.0 T: Value of current, largely fossil-fuel based, “legacy” energy infrastructure
- \$ 2.5 T (\$250 B/y): Investment needed to reach net-zero emissions by 2030
- \$ 56 B: Investment in renewable energy systems in 2019
- \$ *2.0 T (\$200 B/y): Biden Climate Plan “Power Sector“, if spread over 10 years

*(Includes infrastructure, auto industry, transit, buildings, housing, innovation, agriculture & conservation, environmental justice)

Must include systems integration for both demand side (conservation) and supply side

U.S. legacy system estimate: Daniel Nocera, et al., Harvard University

U.S. net-zero transition estimate: Princeton University

Why not use as much of America’s legacy infrastructure as possible?

U.S. Legislative & Political Landscape

Green New Deal

Democratic House Select Committee (HSC) climate crisis report

- Elements of infrastructure spending in Biden climate bill
- Just under 500 regulations and mandates

Biden climate bill, CO₂ emissions reduction mechanisms

- Carbon price: politically sensitive
- Clean air standards: SCOTUS nullification, EU (and other) tariffs, No direct global impact, discourages “redirection” of private sector investment, including fossil energy co’s
- Carbon price may play “firewall” role in final legislation language
- Nature of carbon price not clear; Yellen, Kerry favor carbon “fee”

Bills reintroduced from the previous (116th) Congress (e.g., EICDA)

The Energy Innovation Act

Energy Innovation AND Carbon Dividend Act

THE BIPARTISAN CLIMATE
SOLUTION

Support

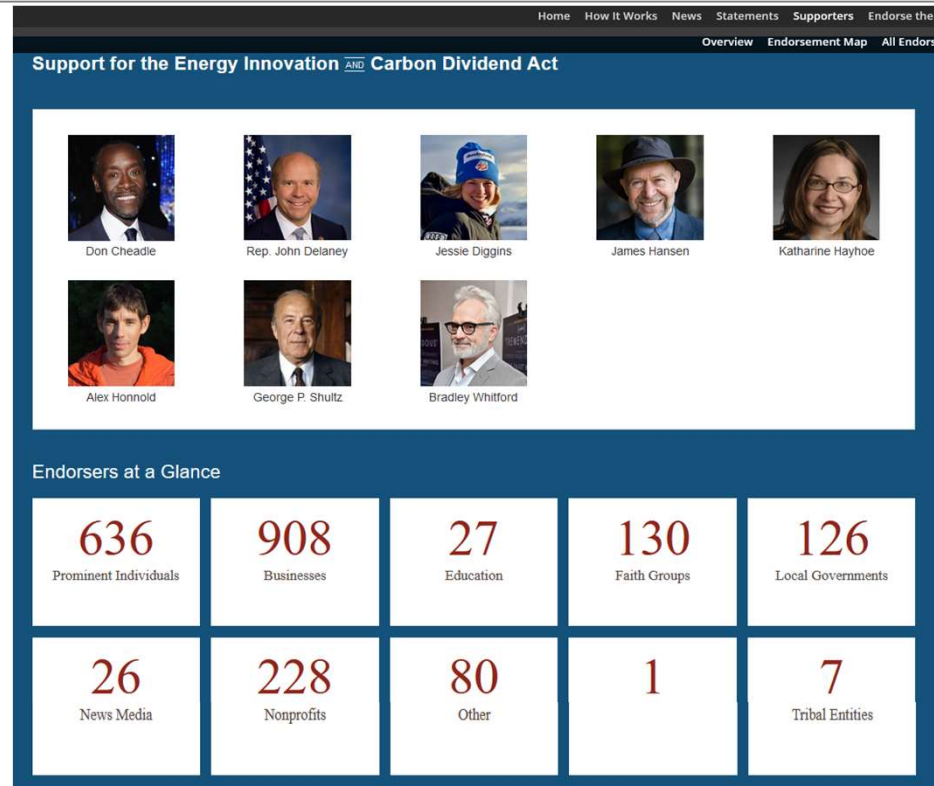


A healthy, stable, and prosperous America

The Energy Innovation and Carbon Dividend Act will drive down America's carbon pollution and bring climate change under control, while unleashing American technology innovation and ingenuity. This policy was introduced in the House in 2019 as [H.R. 763](#). It was also introduced in the Senate in 2018 as [S. 3791](#).

EICDA will be reintroduced soon in the 117th Congress

Building Support for EICDA at Many Levels



This diverse and wide range of support continues to grow...

Support from a Familiar Organization

Energy Innovation AND Carbon Dividend Act Public Statements

What Others are saying about the Energy Innovation Act

Alliance for Market Solutions

We commend Congressmen Ted Deutch and Francis Rooney for reintroducing their carbon tax legislation. They, along with economists, recognize that a carbon tax is the serious solution to climate change. A revenue-neutral carbon tax can spur economic growth and transform our energy economy, unlike other non-market-based proposals like the Green New Deal that rely on subsidies and regulations.

Center for Climate and Energy Solutions – C2ES

This ambitious, bipartisan proposal underscores the growing momentum in Washington for climate solutions. The recent National Climate Assessment and IPCC Special Report make clearer than ever that we need action now. This kind of comprehensive market-based approach is key to decarbonizing the U.S. economy. It can protect our communities and infrastructure from growing climate risks while contributing to strong, sustainable economic growth.

Unitarian Universalist Association

The Energy Innovation and Carbon Dividend Act incentivizes fossil fuel reduction, supports alternative energies, and sends money back into households. These are all excellent strategies for combating climate change. This legislation is supported by Unitarian Universalists across the country who are working hard to get it passed. UUA President Rev Susan Frederick-Gray states: "May our love of this blue green earth feed our souls to act on its behalf. Whether we choose to put our bodies in front of a pipeline or throw our considerable energies into legislation for just energy transitions, may we do so centering the margins." It will take all of us and many strategies to create climate justice, including passage by the 116th Congress of the EICDA.

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United States Conference of Catholic Bishops

This bipartisan bill is a hopeful sign that more and more, climate change is beginning to be seen as a crucial moral issue, one that concerns all people. If enacted, this proposal is expected to result in significant reductions in greenhouse gas emissions. At a time when the dangerous effects of climate change are becoming increasingly apparent, the need for legislative solutions like this is more urgent than ever.

Fundamentally, this bill is about ensuring that the full spectrum of costs associated with greenhouse gas emissions—economic, social, and environmental—are accounted for. Failing to consider the health and well-being of people, including future generations and the planet, means that "businesses profit by calculating and paying only a fraction of the costs involved" (Laudato Si', no. 195). This proposed legislation is one possible remedy to addressing these imbalances.

Supporting EICA via Citizens' Climate Lobby

CCL: Respectfully building political will for a *price on carbon*

**Our solution to
climate change?
Democracy.**

And we need you on our team.

[Join Us](#)



**Republicans & Democrats working
together.**

Other opportunities with CCL action teams and your local CCL chapter

Citizens' Climate Lobby (CCL)

Respectfully building political will for a *price on carbon*



Local CCL chapter members lobbying Congress and tabling

Reaching out to Congress

Step 1: Sign up for CCL



**Next campaign,
March 22nd- 26th**

Building momentum for the “First 100 days” window of hope

CCL Community/Education

My Dashboard

The screenshot shows the 'My Dashboard' page of the Citizens' Climate Lobby website. The page is organized into several sections:

- Log and Track Actions:** Includes an 'Action Tracker' link.
- My Bookmarks:** Shows 'No saved bookmarks.'
- My CCL Community Groups:** Lists several action teams: Business Climate Leaders Action Team, Economics Policy Network Action Team, Grasstops Engagement Action Team, and MA Boston-Metro West.
- My Tools:** Lists various tools: Action Tracker (Field Reports), CCL Stats, Grasstops Tracker, Meeting Minutes, Monthly Calling Campaign, Chapter Roster, and All tools -->.
- Featured Content:**
 - New President, Climate Opportunity:** A video thumbnail featuring Dr. Danny Richter, with text: 'CCL's Dr. Danny Richter weighs in about what the new administration and new Congress mean for our work on climate change. Watch here.'
 - Jan. Actions & Monthly Speaker:** A video thumbnail featuring Dr. Noah Kaufman, with text: 'Dr. Noah Kaufman (Columbia Univ. economist) joined us Sat. Jan. 9th. Learn more about his team's important recent research: More info here.'
- Community Bulletin:** A blue banner with the text 'Three of CCL's lobbying asks pass Congress & become law!' and a 'Share on Facebook' button.
- Community Bulletin:** A section with a photo of Tony Campolo and text: 'Citizens' Climate Radio Ep. 56: Rev. Tony Campolo's Call To Save Creation'. Next to it is a green wrench and hammer icon and text: 'CCL Community Release - January 15, 2021'.

Intended to be the starting point to everything CCL

Topic

“Call Congress Day” Info & Training

Community Dashboard Resources and Training Tools Connect Events Help Search..

Call Congress

Dashboard > Topics > Contacting Congress > Call Congress

< Back to Topics

Lobbying

Working With Congress ▾

Congressional In-District Activities ▾

Contact Congress ▲

Call Congress

Tweet Congress

Write Congress

Deliver Letters to Congress

Starting A Monthly Calling Campaign

Social Media for Lobbying ▾

Legislative Strategy ▾

! Citizens' Climate is adapting to COVID-19. Some resources on this site may need adjusting to current circumstances. [More Info.](#)

Call Congress

Description

Calling your Senators and Representative helps create the political will needed to solve global warming by demonstrating constituent concern. Call your members of Congress to amplify our voices and help move Congress closer to enacting the Energy Innovation and Carbon Dividend Action.

Select a tab below to read, watch or listen to this training.

Read

In This Training

1. [Getting started](#)
2. [Sample Script](#)
3. [Tips for generating more calls during Call Congress Campaigns](#)

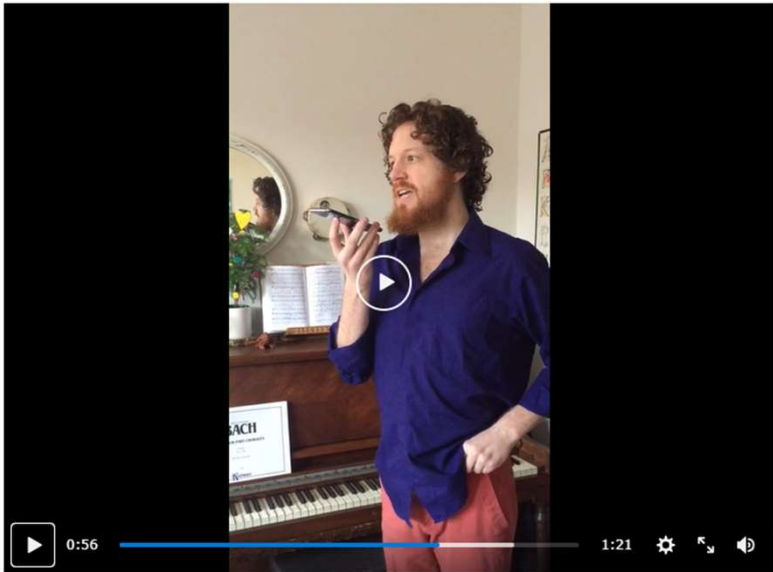
<https://community.citizensclimate.org/resources/item/19/376>

Help for You via CCL Social Media


Example on reddit of how to call your congress rep

Posted by u/alexmariani Verified CCL Volunteer 1 month ago

146 Nervous about calling Congress? Here's how I do it.



15 Comments Share Save Hide Report 99% Upvoted

 r/CitizensClimateLobby

We exist to empower Redditors to have breakthroughs in their personal and political power while we build broad support from all major players for meaningful climate legislation. Citizens' Climate Lobby is an international volunteer organization dedicated to the passage of science-backed national climate legislation that drastically reduces emissions without overburdening the poor. This subreddit is operated by Citizens' Climate Lobby volunteers.

4.4k Members 6 Online

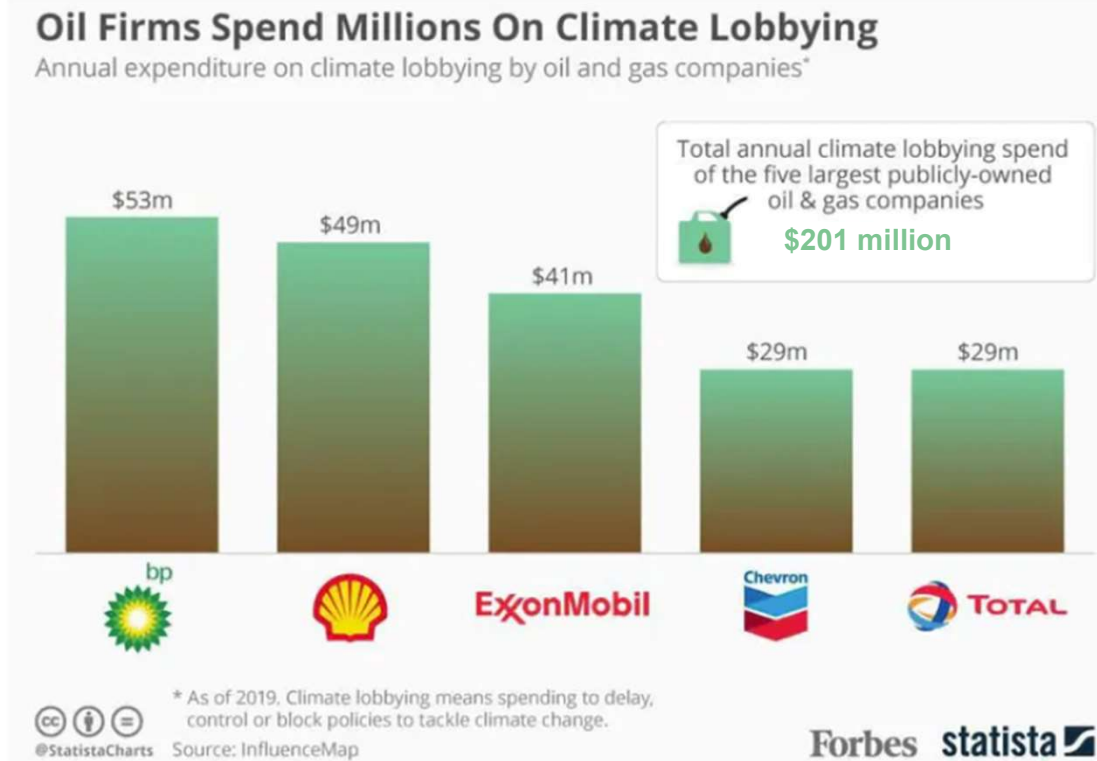
Created Jun 23, 2016

Join

ADVERTISEMENT

Citizen's climate lobbyists are up against some tough competition!

David, Meet Goliath: The Denialist Coalition



Another **\$60 – \$70 million** comes from ideologically motivated family foundations, including

- Donors Trust/Capital
- Scaife Affiliated Foundations
- The Lynde and Harry Bradley Foundation
- Koch Affiliated Foundations
- Howard Charitable Foundation
- John William Pope Foundation
- Searle Freedom Trust
- John Templeton Foundation
- Dunn's Foundation for the Advancement of Right Thinking (*Dunn's FART?*)
- Smith Richardson Foundation, Inc.
- Etc.....

Center for International Environmental Law (CIEL), 2014

We should remember that David won

Reaching out to Congress

Lobbying days, March 22nd – 26th

Includes “Call your legislator day”

Winchester congress members (for at least most of you) are as follows:

US Rep Ayanna Pressley (617) 850-0040

US Rep Katherine Clark (617) 354-0292

US Rep Seth Moulton (978) 531-1669

US Senator Elizabeth Warren (617) 565-3170

US Senator Edward Markey (617) 565-8519

This is the year. This is the moment.



Are You Ready to Take Action?

Citizens' Climate Lobby <https://CitizensClimateLobby.org/> (Look in the Zoom share)

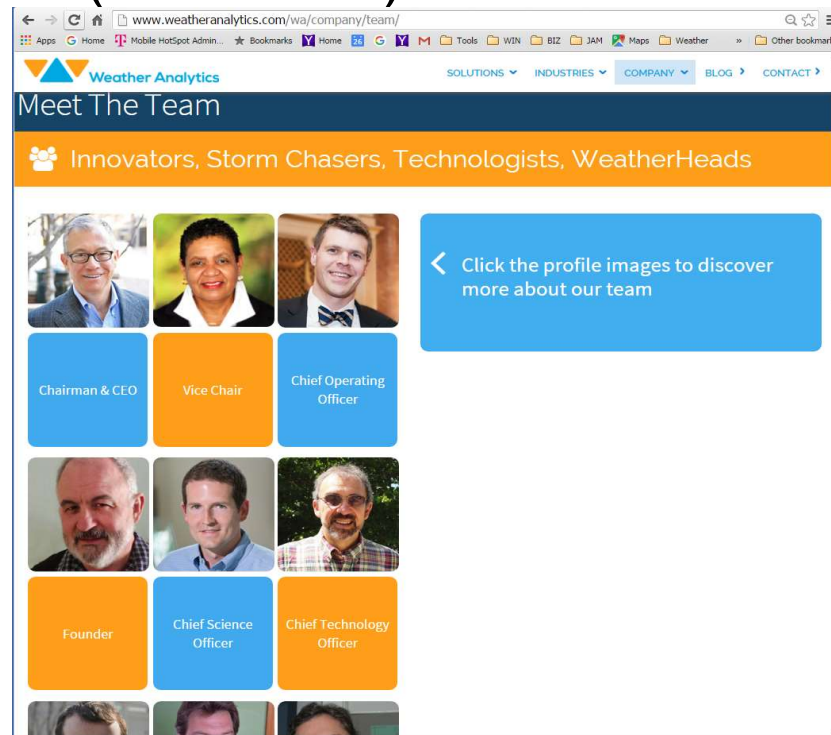


Support is growing. At your marks, ready, set,...

Final Talk Content Part 2

Meeting the Challenge of Climate Change

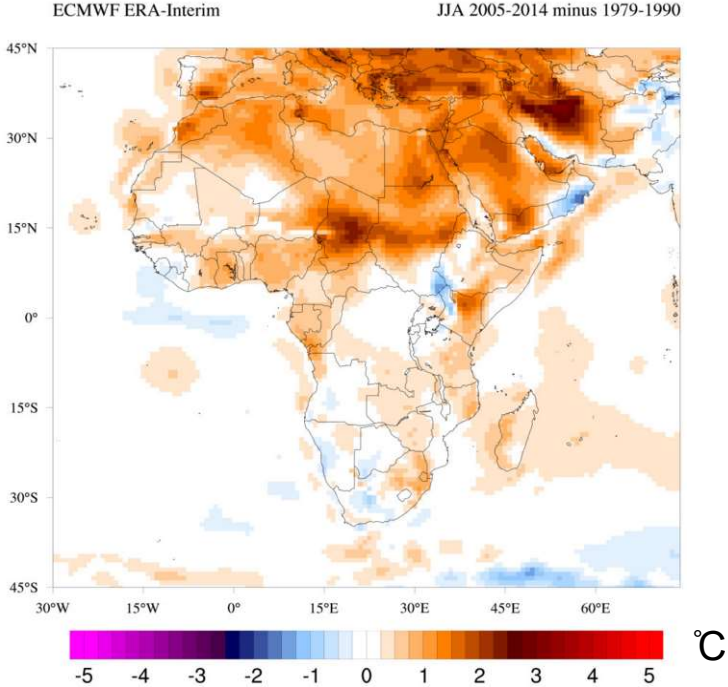
My background (continued): co-founder of Athenium, LLC



<http://www.Athenium.com/>

Meeting the Challenge of Climate Change

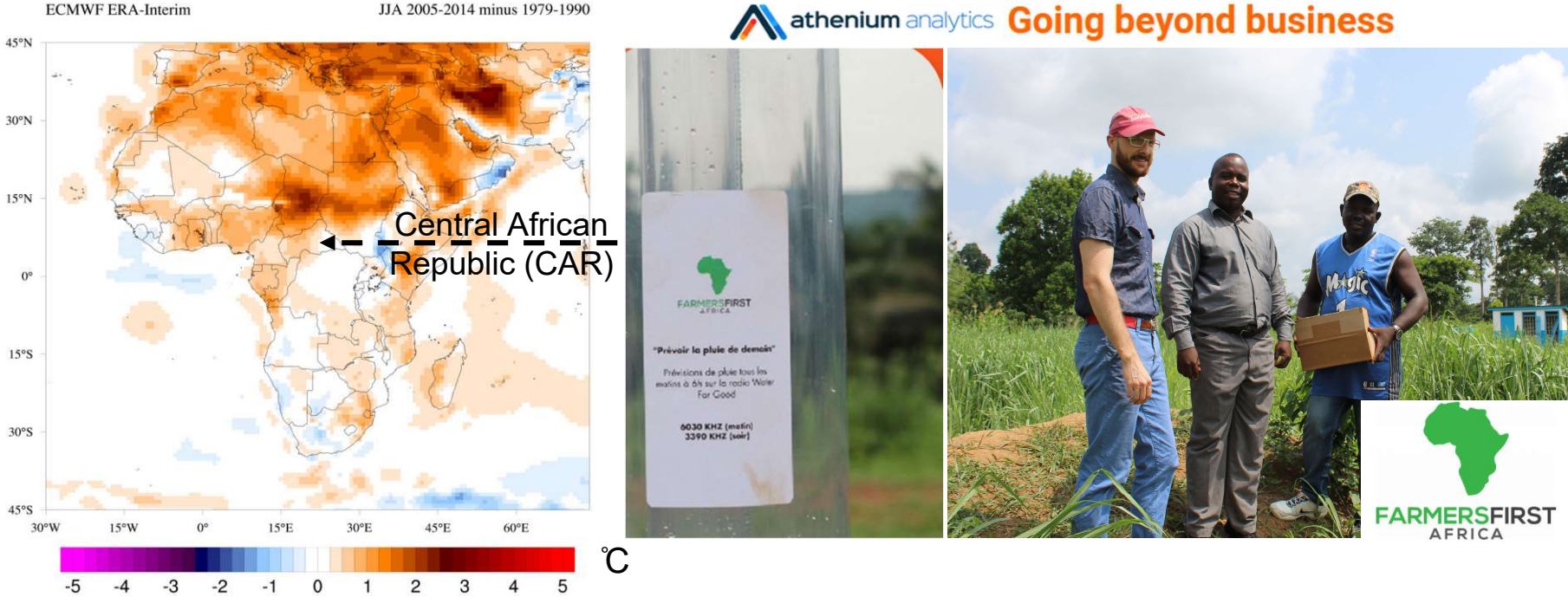
Athenium provides the numbers behind the maps



Average change in summer temperature since 1980s, Africa and Mideast

Meeting the Challenge of Climate Change

Athenium's technical support of African farmers



Lack of electricity frustrates climate change adaptation in CAR

The Key to Eliminating Poverty

The human condition and energy availability are closely linked

Ave. American > 10 KW



Ave. European ~ 1/2 American



Ave. African < 1/10 American

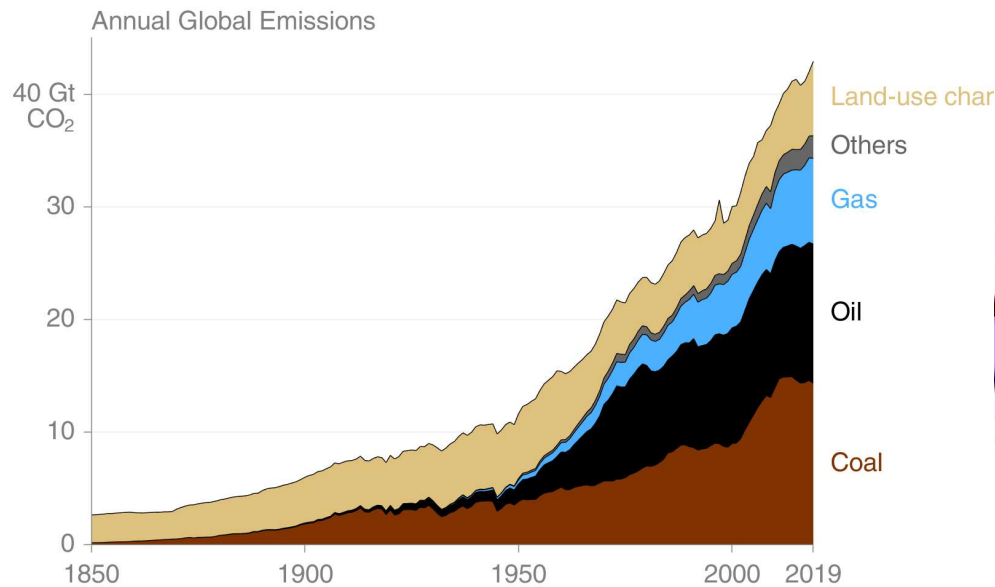


A global “European standard” by 2050, power generation must increase from 17 TW to 32 TW

Can the future of the developing world be based on fossil energy?

Total Global Emissions, All Sources

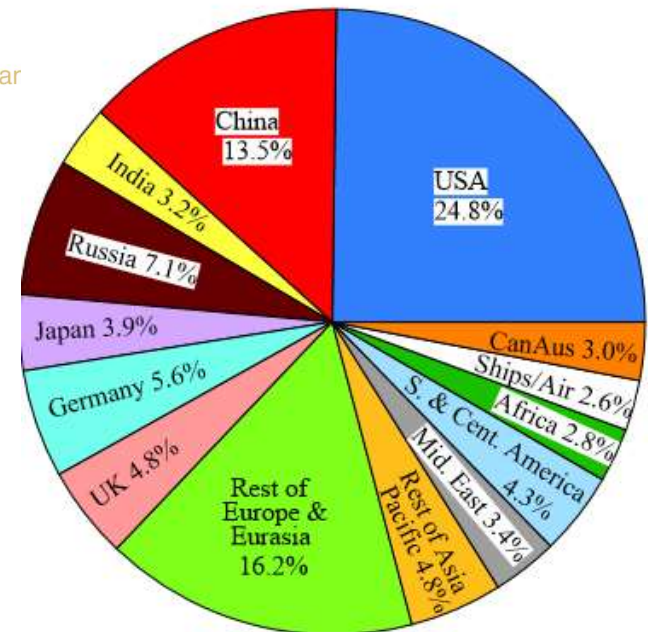
Land-use change was the dominant source of annual CO₂ emissions until around 1950.
Fossil CO₂ emissions now dominate global changes.



©Global Carbon Project • Data: CDIAC/GCP/UNFCCC/BP/USGS

Others: Emissions from cement production and gas flaring

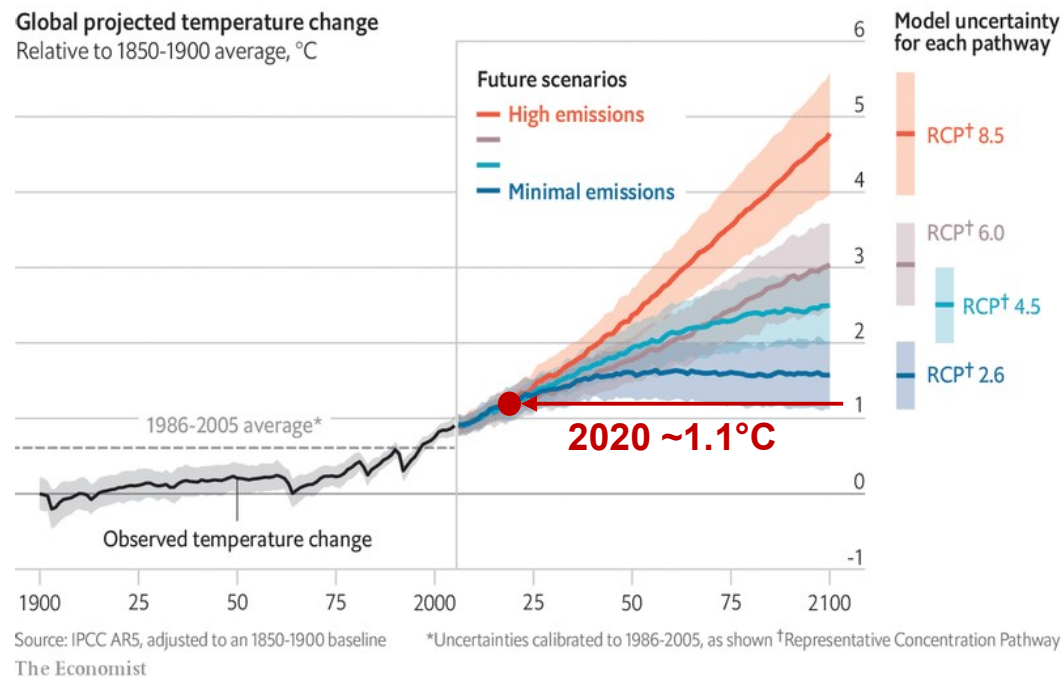
1751–2018 Cumulative Emissions (442 GtC)



Source: [CDIAC](#); [Houghton and Nassikas 2017](#); [Hansis et al 2015](#); [Gasser et al 2020](#); [Friedlingstein et al 2020](#); [Global Carbon Budget 2020](#)

The Threat of Future Emissions

Climate models can guide policy, even if they're not precise



IPCC alternative
“emission paths”

Projected temperatures have shown uncertainty, but have been accurate

The Impacts Are Just Beginning

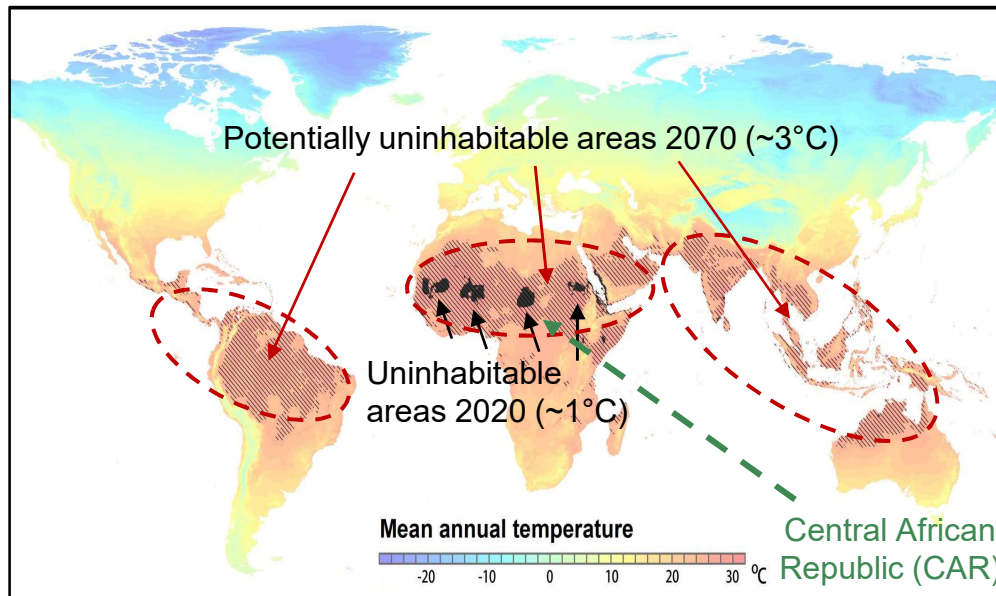
Impacts expected from 3°C of warming

- More severe heat waves and droughts
- More intense storms and floods
- 2-6 feet sea level rise by 2100, several meters more by 2300
- Wildfires
- Declining forests
- Loss of coral reefs
- Mass extinctions on land and at sea
- **Food and water scarcity**
- **Climate refugees**

Some of these impacts are particularly troubling

The Worst Impacts Have Begun

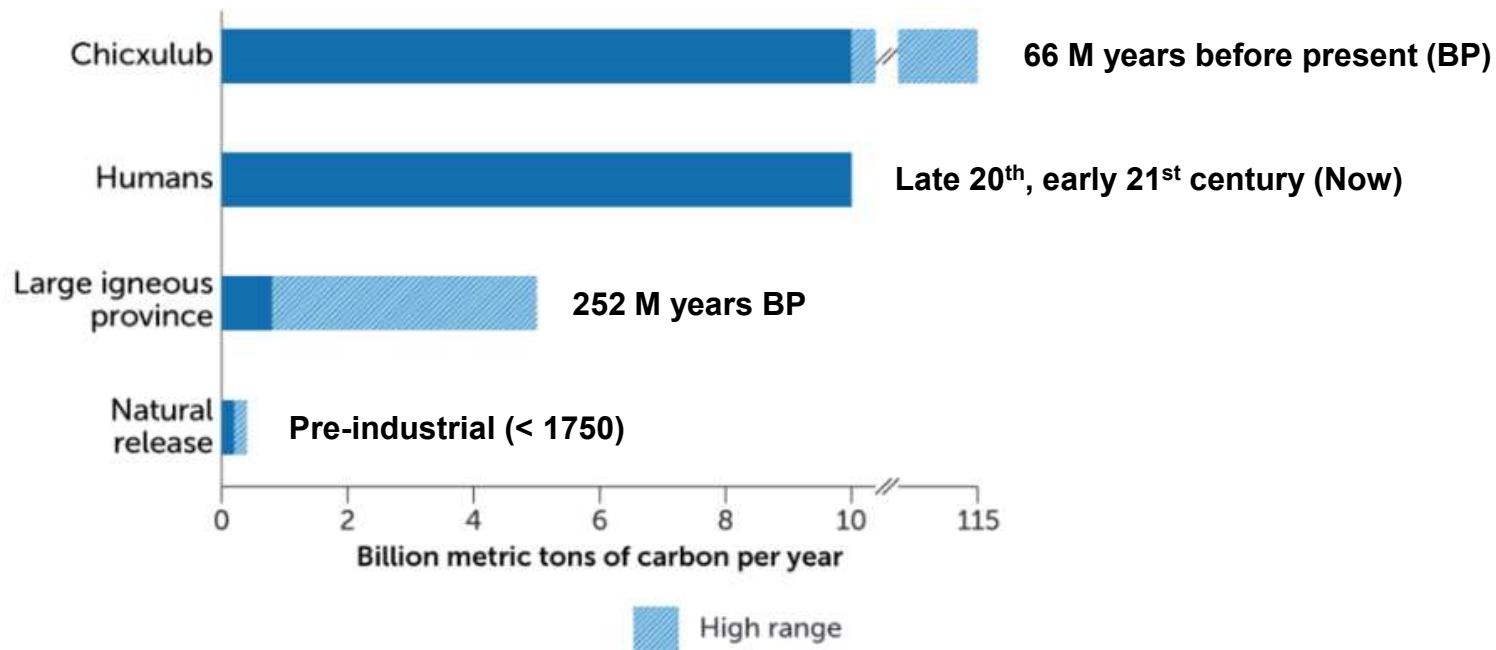
With 3°C of warming, over 1 billion climate refugees



How can we stop this from happening?

Current CO₂ Emission Rates, in Perspective

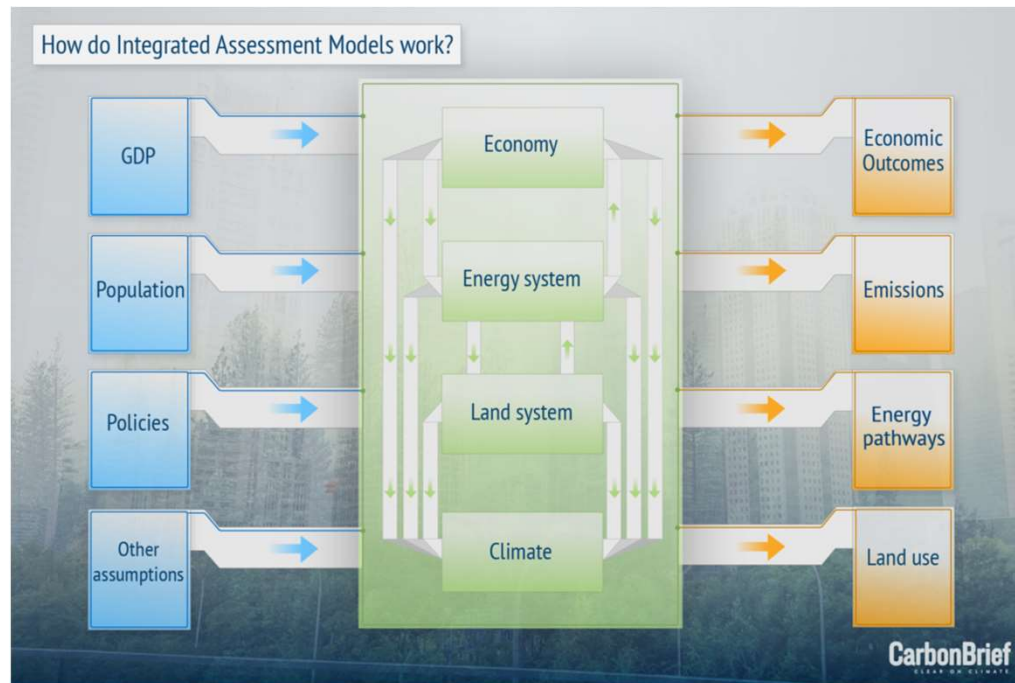
Annual CO₂ emissions: human vs. ancient carbon catastrophes



Human CO₂ emissions rival those of extinction-level asteroid impacts

Are There Effective Solutions?

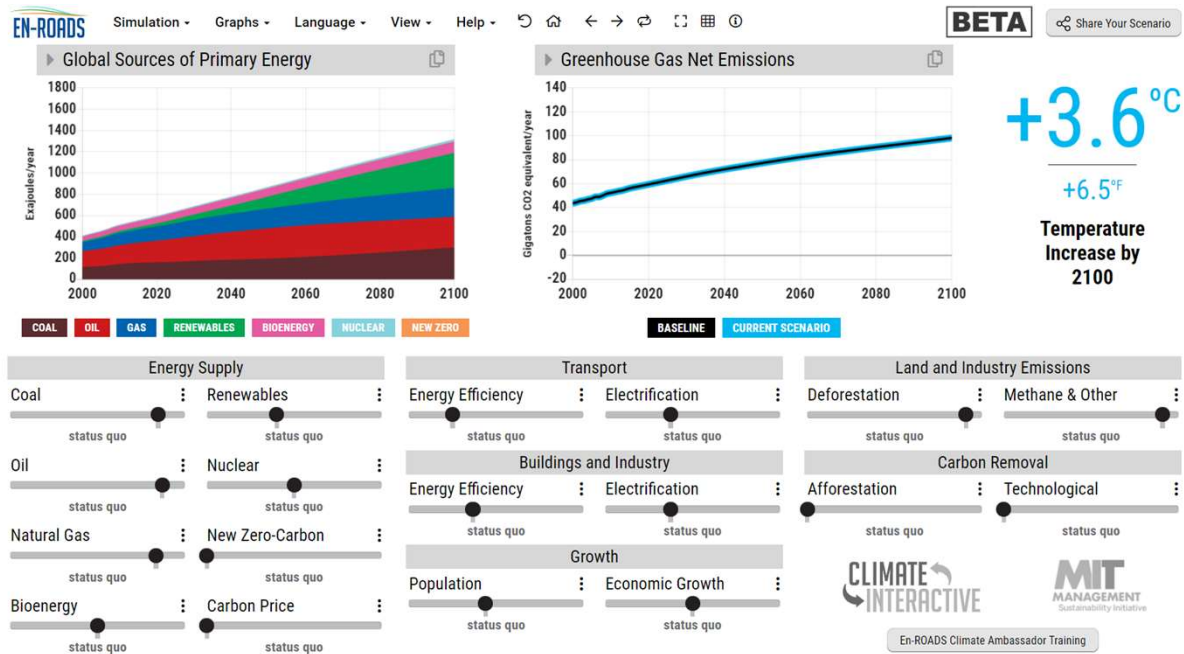
Analytics from Integrated assessment models (IAM's)



There are several IAM's that can provide valuable insights

Meeting the Challenge of Climate Change

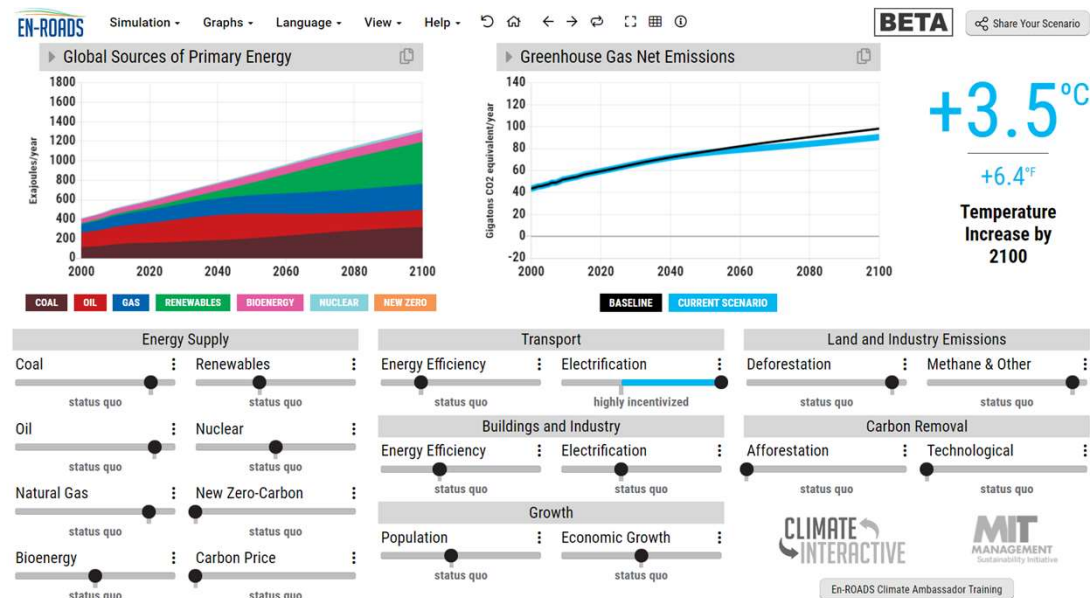
MIT's En-ROADS's baseline projection



En-ROADS is available online to all

Meeting the Challenge of Climate Change

An example: En-ROADS's result for 100% EV's

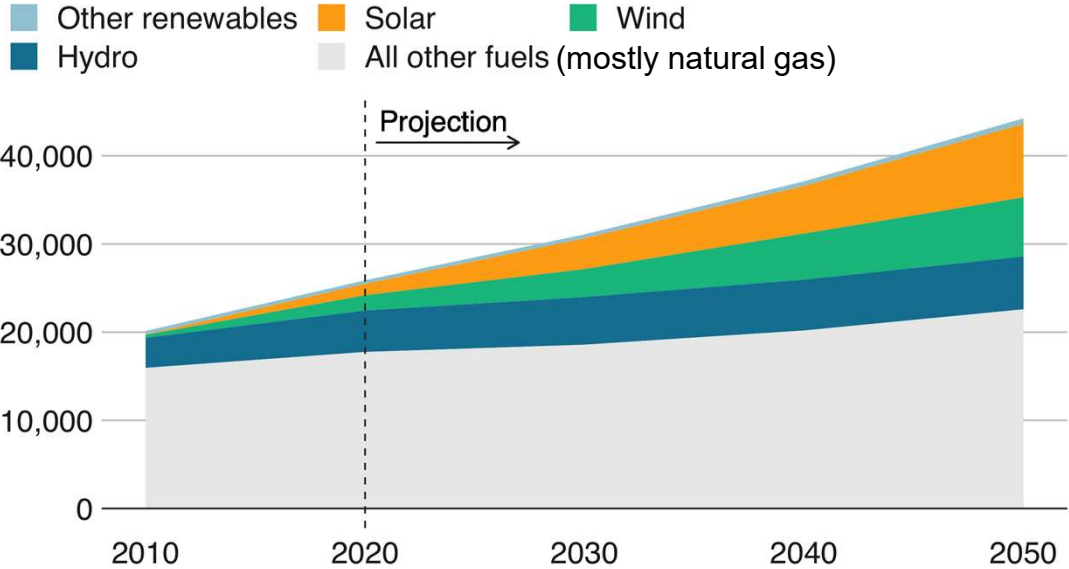


Why is it that converting to 100 % EV's (globally!) has so little effect?

The Primary Global Fuel Mix by 2050

Half of electricity from renewables by 2050

Electricity generation in trillion kilowatthours



Source: US Energy Information Administration

BBC

For the foreseeable future, EV's will be mostly powered by natural gas

Is the Current Grid Capacity Enough?

Grid Capacity and Transportation Demand (EIA Data)

- US Retail electricity delivery = 13 quads
- On-highway transportation consumption = 22 quads
- Assume electric vehicles are 3x as efficient vs gasoline (EERE) and 2-2.5x diesel (JCW) and setting aside intercity Class 8 → 6.5 quads electricity demand
- **US Retail electricity bulk generation and delivery must increase 50% (...ish, not accounting for battery charging losses...) to support personal and urban commercial vehicle electrification**

John Wall, MIT Climate Action Symposium, February 25, 2020

Is the 50% increase EV's will require is included in the EIA projection?

Insights from En-ROADS

1. There is **no silver bullet** – there's no one solution that will prevent climate change.
2. To achieve ~2° requires "silver buckshot" – success with most everything.
3. **Highest leverage: Keeping fossil fuels in the ground.**
4. Even when low-carbon supply is encouraged and thrives, we still burn fossil fuels.
5. New technologies grow via reinforcing "learning" feedback loops.
6. Energy efficiency starves growth in renewables.
7. When energy becomes inexpensive (e.g., renewables, nuclear, new tech breakthroughs), **energy demand increases via a modest "rebound effect."**
8. Accelerated growth in natural gas (e.g., via subsidy) absent a carbon price starves renewables and mitigates little greenhouse gases.
9. **A brand new technology is too delayed** to contribute much on its own.
10. The transition from high-carbon to low-carbon takes decades due to **long lifetime of fossil fuel capital infrastructure.**
11. In a high-mitigation scenario, more nuclear/new-tech/renewables just displaces the other low-carbon sources.
12. **"Other gases" reduction** mitigates a good bit.
13. GDP changes are high leverage.
14. **A carbon price is high leverage because it changes fuel mix and reduces energy demand.**
15. Reducing deforestation is lower leverage in long term than most expect.



Carbon pricing means you pay for the CO₂ waste you make

Who expects to have free dumping?

Excess CO₂ is the result of a market failure, *not* a moral failure



Pricing CO₂ pollution must be the foundation of any effective policy

Citizens' Climate Lobby's Proposal

Non-partisan and “technology agnostic”

1 Place a predictable, steadily rising fee on fossil fuels at the source (mine, well or port)

2 Return all of the revenue to households equally

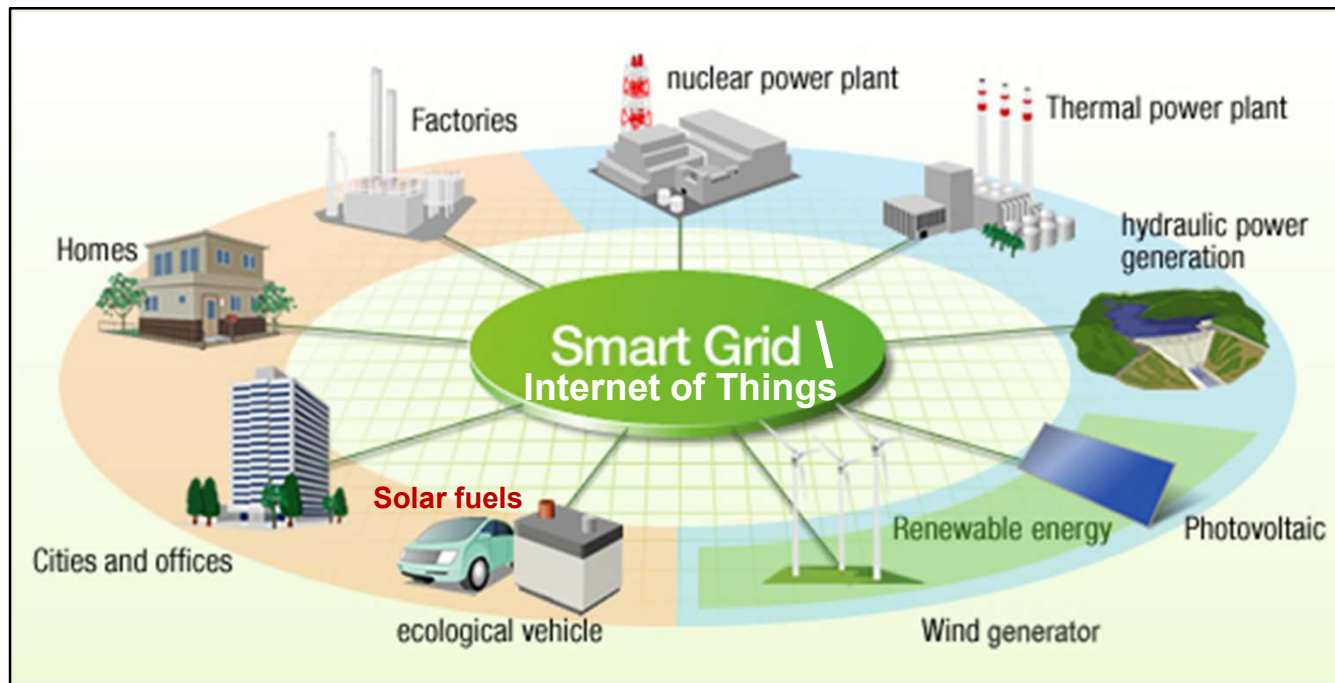
3 A border adjustment on goods imported from or exported to countries without an equivalent price on carbon



Carbon pricing means **energy innovation, *not* energy deprivation**

The Power of a Price Signal

With a carbon fee, deployment investment enters the game



An energy transition without a carbon fee is like a ballet without music

Conservative Estimates of Benefits (US)

Regional Economic Modeling, Inc. (REMI) IAM study highlights

Employment

- **2 million more jobs**

Climate

- ***Dramatically* reduces CO₂ emissions**

Fiscal

- **Increases household incomes**

Health

- **Saves 295,000 lives over 10 years**

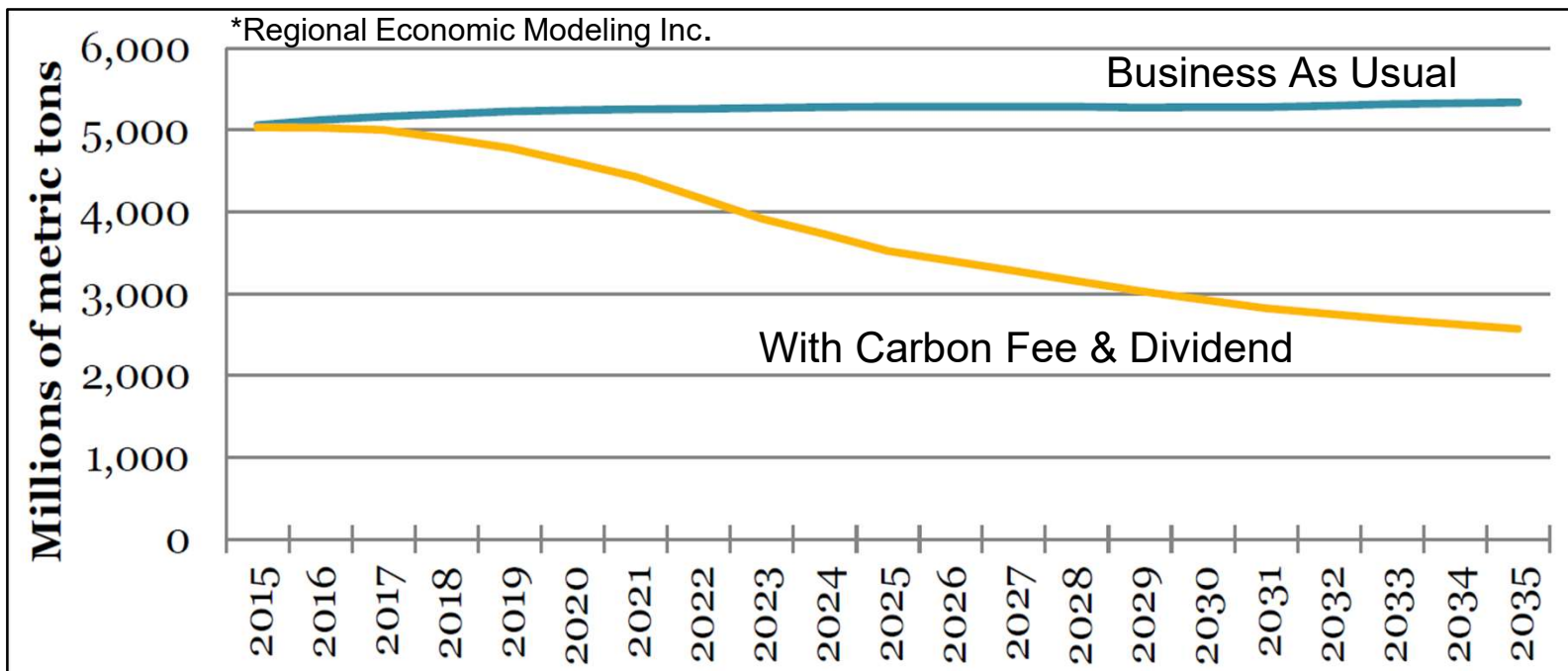
Economic

- **\$1.3 trillion more GDP**

What are we (and congress) waiting for?

An Elegant Solution

REMI* study: US CO₂ emissions reduced by more than half

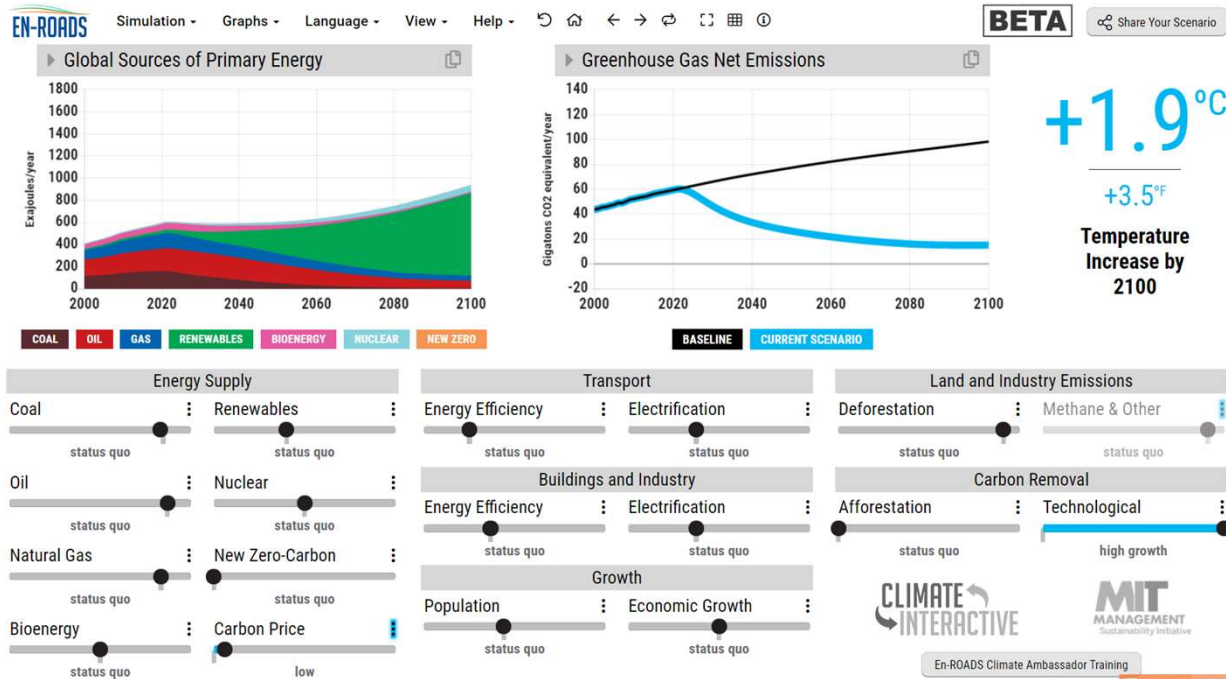


In 20 years US emissions approach equilibrium with natural carbon sinks

Meeting the Challenge of Climate Change

En-ROADS projection under EICDA

Add'l text



As a single policy, carbon pricing under EICDA provides hope

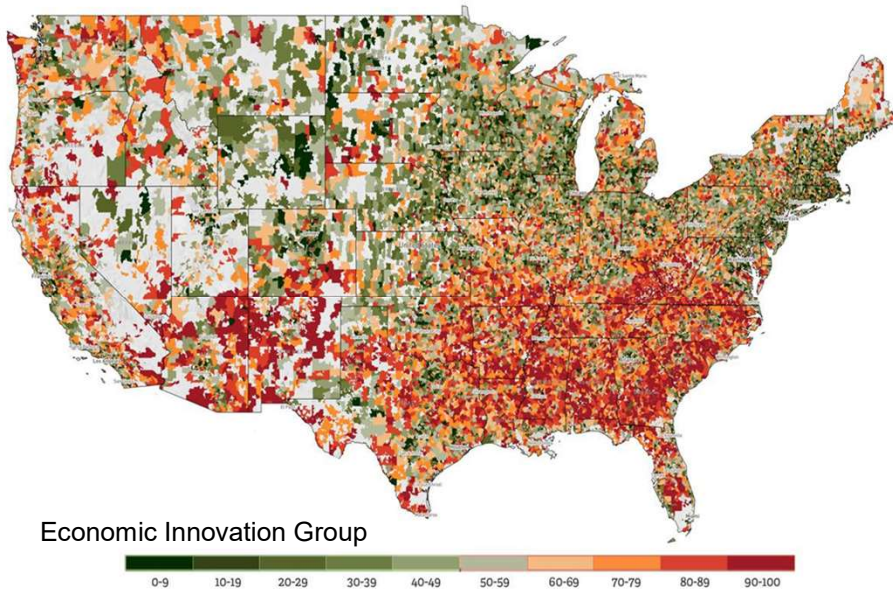
Topic

Citizens' Climate Lobby

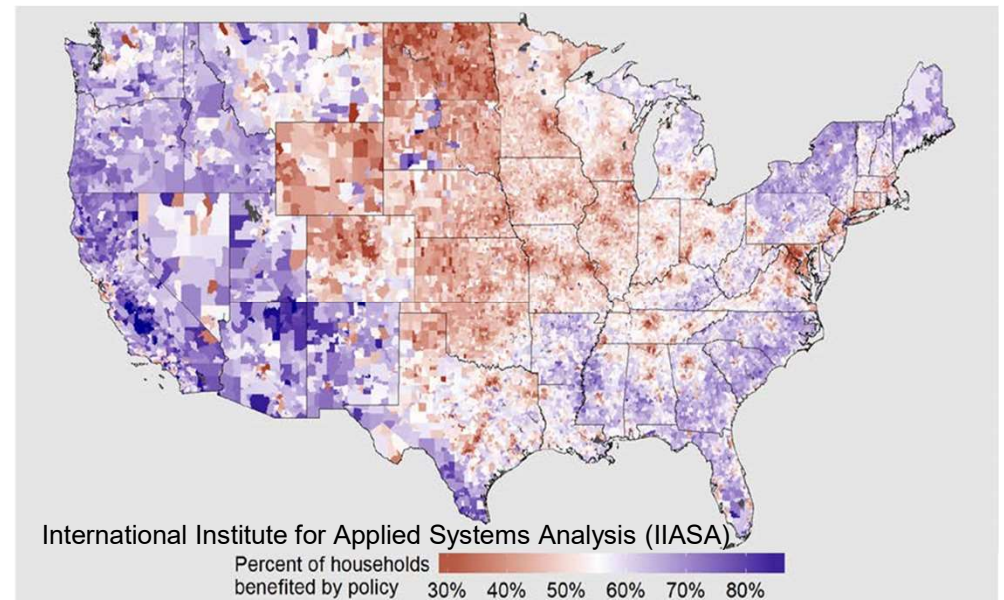
One Important Economic Impact

Those who who are struggling will be helped the most

Distressed communities index, by Zip Code



Percent households benefiting, by Zip Code

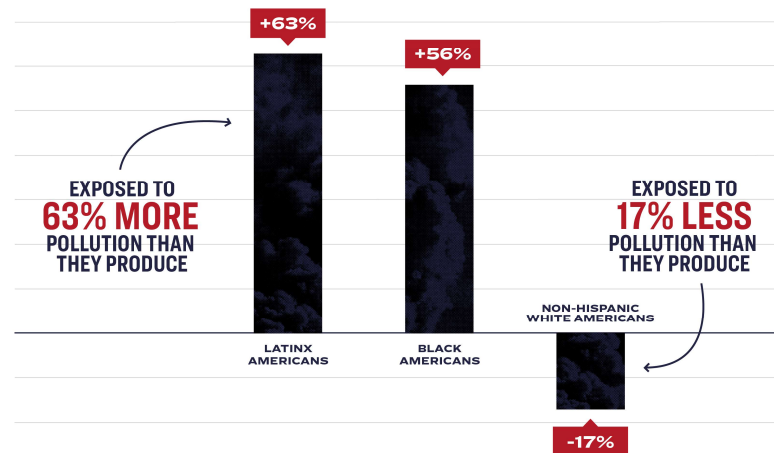


One example of the elegant in elegant solution

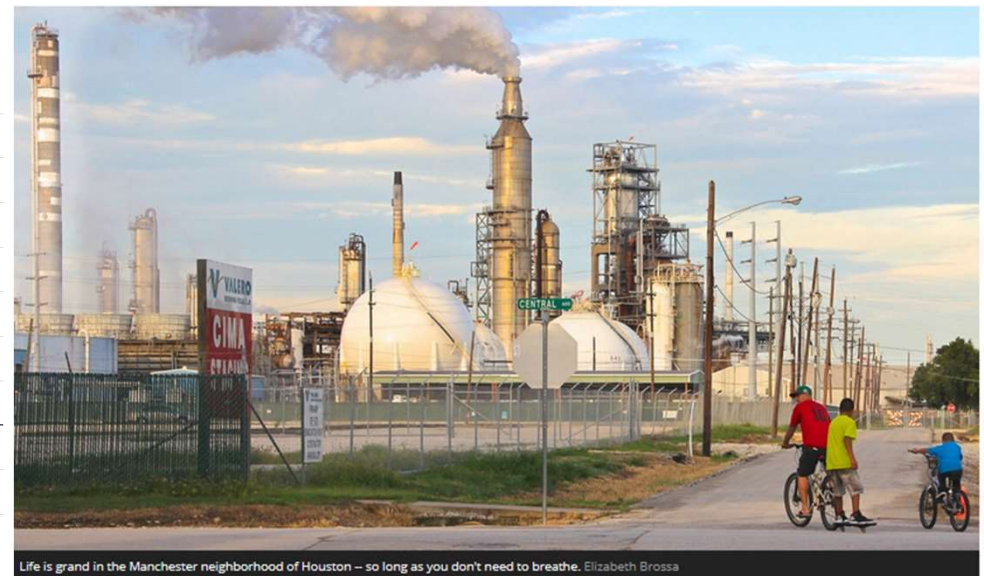
Blood Gas, Blood Oil, Blood Coal,...

Fossil fuel emissions and environmental justice

POLLUTION EXPOSURE BY POPULATION (2003–2015)



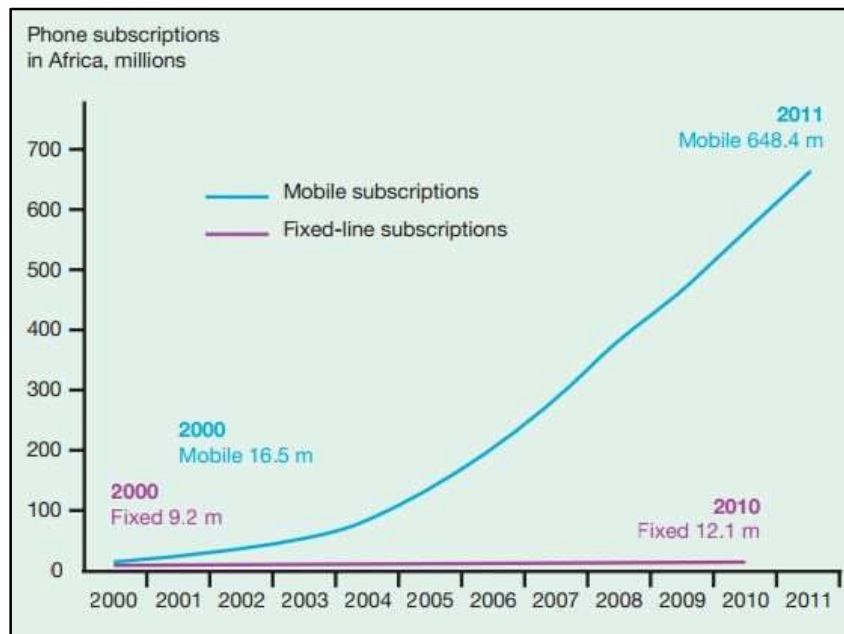
Source: Christopher W. Tessum et al., "Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure," Proceedings of the National Academy of Sciences (March 2019).



Should carbon dividends be viewed as a form of environmental reparations?

Reaching the Developing World

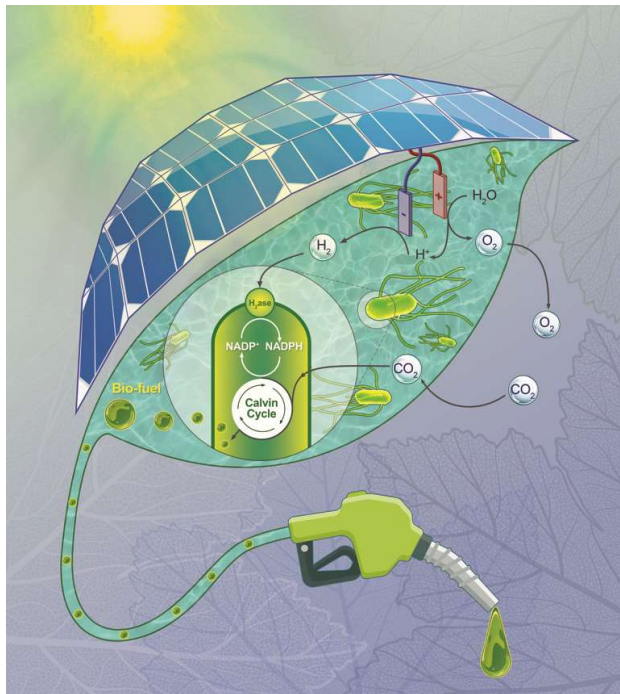
Cellular technology can provide a precedent



Most of the developing world is awash in accessible solar energy

Reaching the Developing World

Daniel Nocera's artificial leaf technology



Artificial Leaf...



The best solution when no centralized energy system exists

Add'l text

Some Takeaways

- Loss of habitat for about 1 B people is humanity's greatest climate risk
- Global energy production will probably double by 2050
- To merely build a net-zero global energy system will cost in the \$trillions
- Much of the \$trillions will be for “systems integration”
- A price on carbon would unleash enormous private sector investment
- Maintaining a safe level of CO₂ is really a waste management problem



Are You Ready to Take Action?

Citizens' Climate Lobby <https://CitizensClimateLobby.org/> (Look in the Zoom share)



Support is growing. At your marks, ready, set,...