

Earth's Climate: Past, Present and Future; Concerns and Solutions

Week 5: Wednesday February 20th, 2019

Paul Belanger

Solutions

Revised syllabus

- <https://denverclimatestudygroup.com/wp-content/uploads/2019/02/Belanger-2019-winter-syllabus-Earth-climate-past-present-future20190213.pdf>

Starting with Today:

Wednesday 1-3, February 13th:

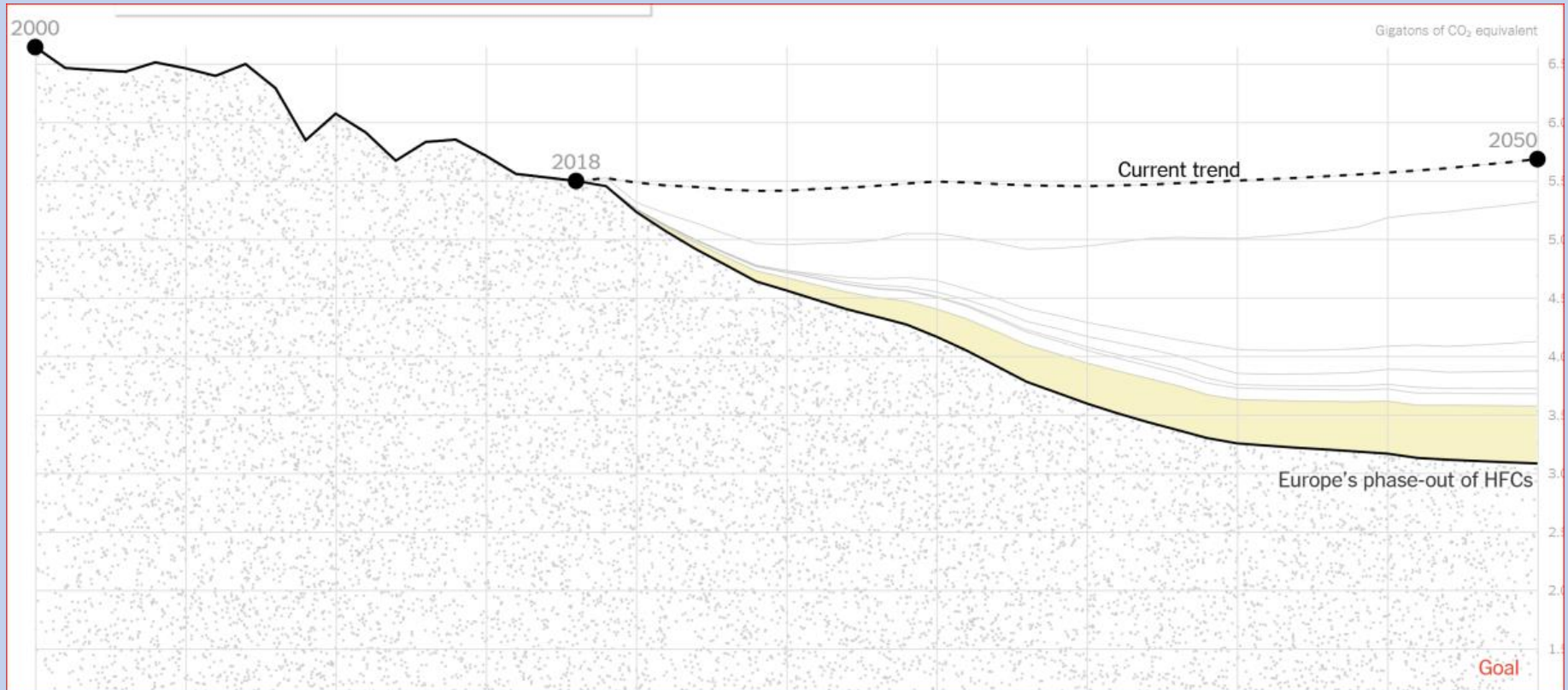
- Models, physics and what do they tell us
- Skepticism vs. Denial:
 - 5 Characteristics
 - List of videos that might be useful: <https://skepticalscience.com/denial101x-videos-and-references.html>
 - Denial 101x: here's a link to a newly available self-paced version of the course I took in April and May: <https://www.edx.org/course/making-sense-of-climate-science-denial-2>
- Industry statements past and present
- Ice coring – see next week list if time permits

Wednesday 1-3, February 20th:

- Antarctic ice cores
- Arctic Ice cores
- What the data tells us
- **REVIEW LAST SLIDE FROM LAST WEEK: Solutions: how to cut emissions!**
- **Solutions Part A: – start of discussion onward (see below)**

LAST WEEK

Solutions - Adoption of 7 policies



- https://www.nytimes.com/interactive/2019/02/13/climate/cut-us-emissions-with-policies-from-other-countries.html?smid=fb-nytimes&smtyp=cur&fbclid=IwAR13rNqUxYrKOomsaKQKotuuYQ1SBUK_IldhZbL0E9INp70f9NHhuy8_Nw

Adoption of 7 policies

- **Carbon tax:** The tax on coal, oil and natural gas starts at \$7.50 per ton of carbon dioxide in 2020 and reaches \$37.50 per ton **by 2033**. This is based on the rates and schedule for [British Columbia's carbon tax](#), which began in 2008. ...
- **Clean electricity standard:** This policy is partly modeled after existing state-level standards. It requires utilities to increase the amount of electricity they produce from carbon-free sources — including wind, solar, nuclear, hydro, geothermal and biomass — until they reach 100 percent clean electricity in 2050. For comparison, California is steadily increasing its [clean electricity requirements](#) to **100 percent by 2045**, while New York has [announced a 2040 goal](#).
- **Electric vehicle push:** Rather than model Norway's [specific set of electric vehicle tax incentives](#), this scenario assumes that the United States makes a push to match the rapid recent growth in Norway's electric vehicle sales over the next eight years. (Between 2011 and 2018, electric vehicles and plug-in hybrids went from 1.6 percent of new sales in **Norway to 49 percent**.) After 2027, ...
- **Industrial efficiency standards:** The industrial efficiency gains are based on a 2016 Department of Energy [study](#)
- **Building codes:** This policy reduces energy use in new homes and buildings. In 2016, the California Energy Commission [calculated](#) that the state's stricter building codes would reduce energy-use intensity by 29 percent for residential buildings and 13 percent for commercial
- **Methane standards:** Canada's [methane rules](#) aim to reduce emissions from oil and gas operations 40 to 45 percent below 2012 levels by 2025. ...
- **HFC phaseout:** This....

IPCC — Intergovernmental Panel on Climate Change

[IPCC — Intergovernmental Panel on Climate Change](https://www.ipcc.ch/) -- <https://www.ipcc.ch/>

IPCC — Intergovernmental Panel on Climate Change

<https://www.ipcc.ch> ▼

The **Intergovernmental Panel on Climate Change** The **Intergovernmental Panel on Climate Change** (**IPCC**) is the United Nations body for assessing the science related to climate change.

Publications and Data

The IPCC prepares comprehensive Assessment Reports about knowledge on ...

Fifth Assessment Report

The Working Group I contribution to the Fifth Assessment Report of the ...

Organization

The IPCC is an organization of governments that are members of the United Nations or ...

Mitigation of Climate

AR5 Climate Change 2014: Mitigation of Climate Change The Working Group III ...

Report

AR5 Synthesis **Report**: Climate Change 2014 The Synthesis **Report** (SYR) of the **IPCC** Fifth ...

Data

IPCC Data The Task Group on Data and Scenario Support for Impact and Climate ...

IPCC REPORTS

Assessment reports (AR #) with 3 working groups:

The screenshot shows the IPCC website's navigation bar with the logo and links for REPORTS, WORKING GROUPS, ACTIVITIES, NEWS, and CALENDAR. On the right, there are icons for FOLLOW and SHARE. The main content area is divided into three columns. The first column, titled 'LATEST AND UPCOMING REPORT', is enclosed in a red box and lists: Global Warming of 1.5°C, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Climate Change and Land, and The Ocean and Cryosphere in a Changing Climate. The second column, titled 'SIXTH ASSESSMENT REPORT' (with 'SIXTH' in a red box), lists: AR6 Synthesis Report: Climate Change 2022, AR6 Climate Change 2021: Impacts, Adaptation and Vulnerability, AR6 Climate Change 2021: Mitigation of Climate Change, and AR6 Climate Change 2021: The Physical Science Basis. The third column, titled 'FIFTH ASSESSMENT REPORT' (with 'FIFTH' in a red box), lists: AR5 Synthesis Report: Climate Change 2014, AR5 Climate Change 2013: The Physical Science Basis, AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability, and AR5 Climate Change 2014: Mitigation of Climate Change.

ipcc REPORTS WORKING GROUPS ACTIVITIES NEWS CALENDAR FOLLOW SHARE

LATEST AND UPCOMING REPORT

- Global Warming of 1.5°C
- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Climate Change and Land
- The Ocean and Cryosphere in a Changing Climate

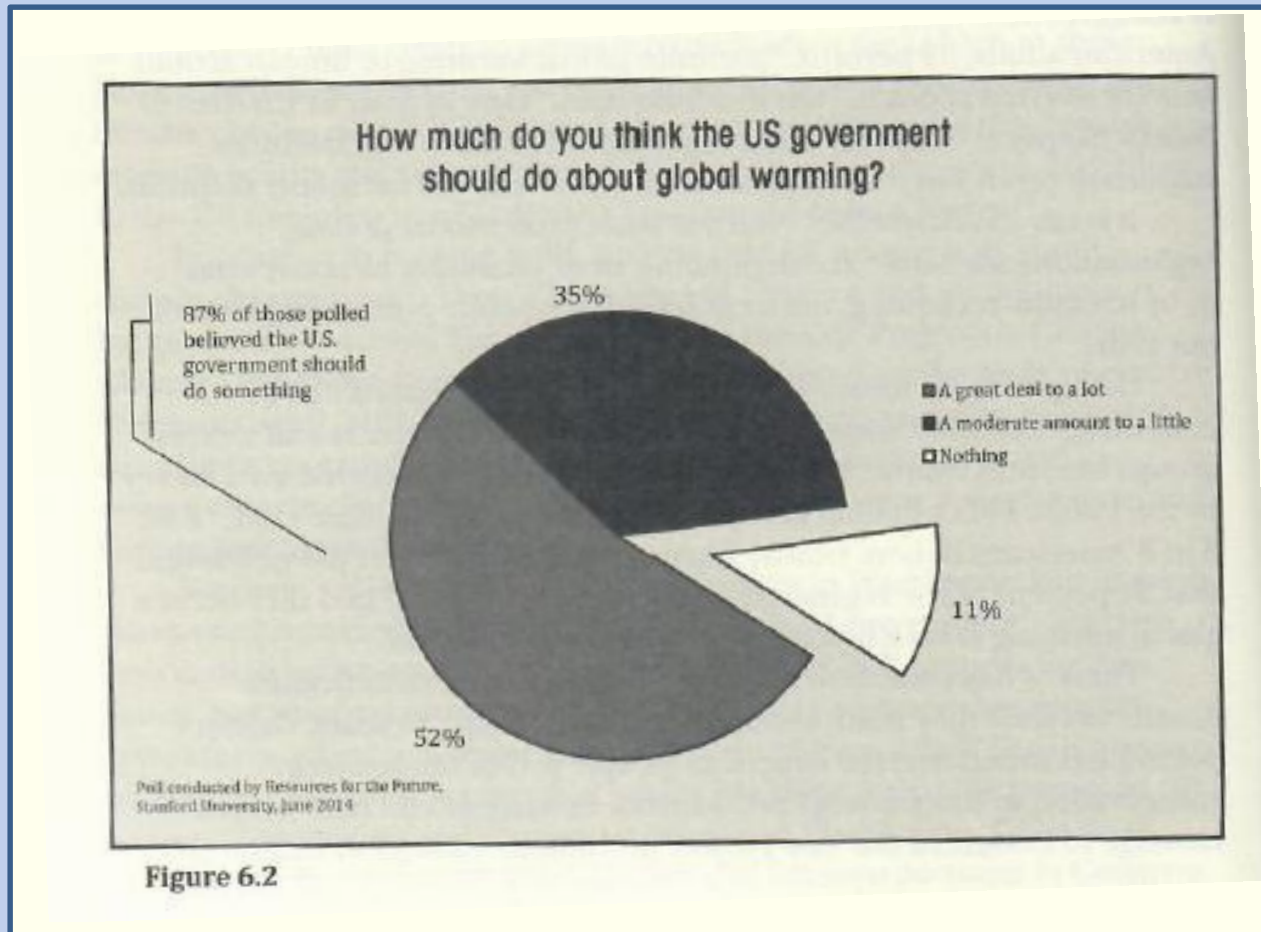
SIXTH ASSESSMENT REPORT

- AR6 Synthesis Report: Climate Change 2022
- AR6 Climate Change 2021: Impacts, Adaptation and Vulnerability
- AR6 Climate Change 2021: Mitigation of Climate Change
- AR6 Climate Change 2021: The Physical Science Basis

FIFTH ASSESSMENT REPORT

- AR5 Synthesis Report: Climate Change 2014
- AR5 Climate Change 2013: The Physical Science Basis
- AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability
- AR5 Climate Change 2014: Mitigation of Climate Change

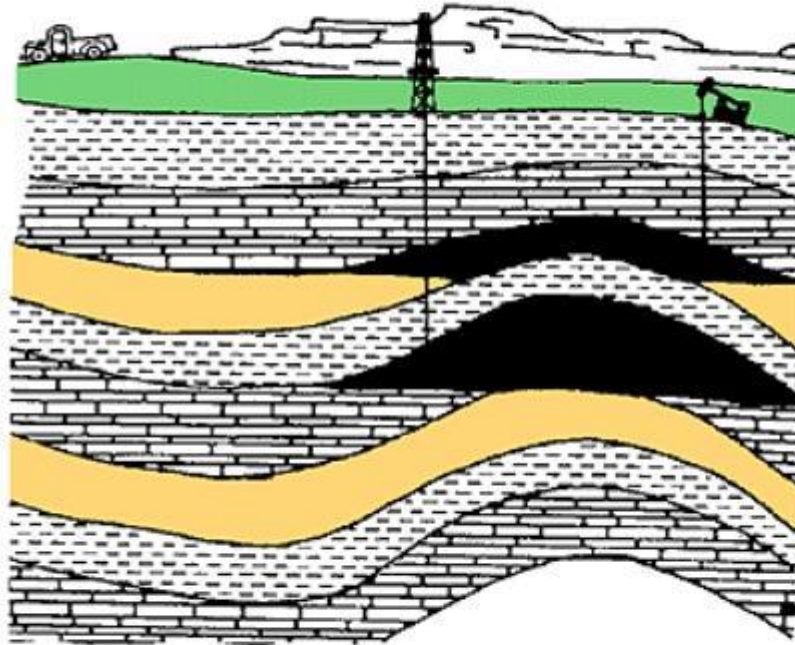
We'd like the role of Government BUT IT DOES NOT LOOK PROMISING RIGHT NOW?



Fossil fuels: oil, gas, coal

- We owe a lot to fossil fuels
- It's only recently we've fully appreciated its consequences
- It's time for change!

Fossil Fuels

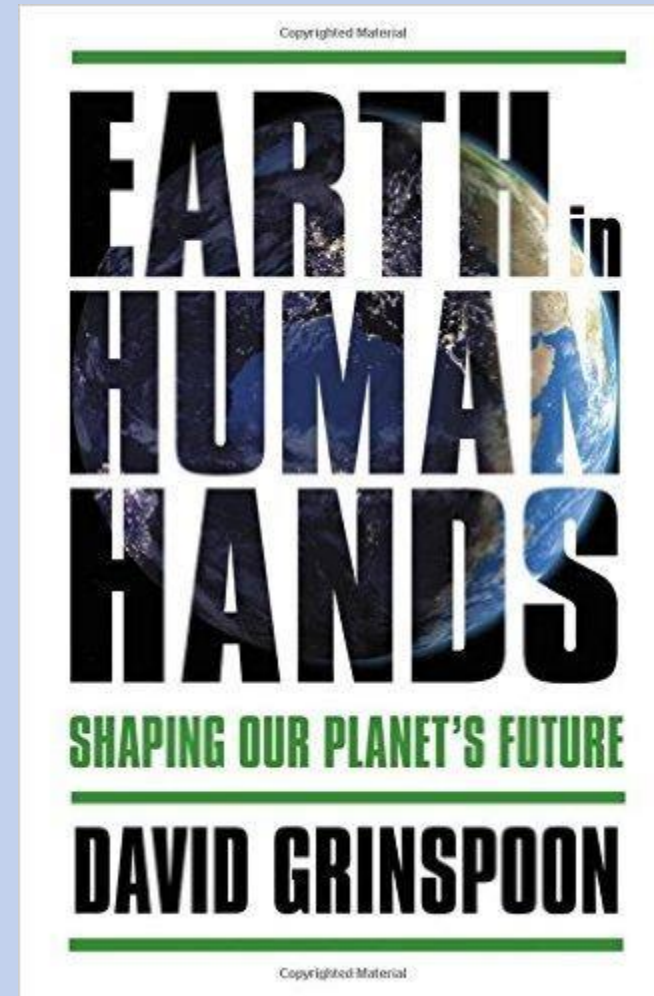


Some of the stored solar energy in biomass can be **preserved in fossilized remains**

We are a planet with brains

- Climate change is only the most visible of the modifications we've made--up until this point, inadvertently--to the planet.
- And our current behavior threatens not only our own future but that of countless other creatures.
- ...shows what a strange and novel development it is for a species to evolve to build machines, and ultimately, global societies with world-shaping influence.

BTW – David Grinspoon will be at Conf. World Affairs (CWA), Boulder NEXT week of 4/8: <http://www.colorado.edu/cwa/>



Solutions

What's it take? A very complex issue

- Policy changes – How to Effect change?
- Cooperation and Resolve – How to agree – COP = Conference of Parties (COP21 = aka Paris agreement)
- Economic changes
- Sustainable practices – large and small scale
- Lifestyle changes

Youth Movement

- <https://www.theguardian.com/commentisfree/2019/feb/15/planet-children-protest-climate-change-speech>

March 24, 2017

Common Dreams | Colorado Youth Score Decisive Legal Victory Against Fracking Industry



Xiutezcatl Martinez, 16-year-old plaintiff and youth director of the Boulder-based Earth Guardians,









<https://www.ourchildrenstrust.org/news>

Dr. James E. Hansen

- July, 2017: [Video for "Young People's Burden"](#)
- March, 2017: [Sophie Sez #3: \\$1,000 for you - and a better world for your children.](#)
[\(Transcript\)](#)
- March, 2017: [Sophie Sez #2: Obama Missed A Golden Opportunity - but We Can Still Win!](#)
[\(Transcript\)](#)

Adapting to Climate change: Extreme Weather Events, a Worldwide Energy Revolution and Geoengineering options

Paul Belanger, Ph.D.; & Phil Nelson, Ph.D.
Geologist/Paleoclimatologist; & Geophysicist
SPRING 2017

-  WEEK 1-adapt intro
-  WEEK 2-heat extreme wx
-  Week 3-too much water
-  Week 4 - carbon tax Energy intro
-  Week 5 - Wind and Solar
-  Week 6 - nuclear grid vs storage
-  Week 7 20170508 NREL VISIT
-  Week 8 - solutions BIOCHAR

**My OLLI archive -
Spring 2017 – top of
the page:**

https://denverclimatestudygroup.com/?page_id=2224

SOLUTIONS – Energy, Transportation and Geoengineering Options

Changing our energy needs

- Economize ANY Energy usage: insulate, reduce trips
- Decarbonize Energy for Generating Electricity
 - Electrify everything for cooking, heating, manufacturing – EVERYTHING
- Decarbonize Energy for Transportation
 - EVs, Fuel cells,
- Why that is not enough = Geoengineering options
 - SRM – SOLAR RADIATION MANAGEMENT
 - CDR – CARBON DIOXIDE REMOVAL

How to achieve solutions

HIT the WALLET

- Fee/dividend or tax carbon
- Remove fossil fuel subsidies
- Incentivize non-carbon sources of energy and transportation

REDUCE EMISSIONS

SEQUESTER SOME

CHANGE OUR LIFESTYLES

Sustainability Economics

- Herman Daly – Steady State Economics
- Alec Tsoucatos – OLLI instructor; also involved EEEF
- Kate Raworth – Doughnut Economics
- Paul Sutton – DU Sustainability and EEEF

This Monday: Ethics and Ecological Economics Forum (EEEEF)

Ethics and Ecological Economics Forum (EEE)

THIS PAGE WAS UPDATED 2/17/2019

NEXT MEETING: February 25th, 2019 1:30 – 3:00 p.m. –

**THE GREEN NEW DEAL: IS IT NEW? IS IT VITAL FOR OUR
FUTURE?**

WHEN: Monday, February 25th, 1:30 – 3:00pm

WHERE: Library Portico, Iliff School of Theology (2323 E. Iliff Ave.)

SPONSORED BY: Ethics and Ecological Economics (EEE) Forum at Iliff

On February 7th, Rep. **Alexandria Ocasio-Cortez** (D-N.Y.) and Sen. **Edward Markey** (D-Mass.) introduced resolutions in the House and Senate, calling for the “Federal Government to create a **Green New Deal** [GND].”

In brief, the GND proposes that the federal government take the lead in responding comprehensively to the growing threats of climate change, wage stagnation, income inequality, and the inaccessibility of basic needs (“such as clean air, clean water, healthy food and adequate health care, housing, transportation, and education”) for “a significant portion of the

https://denverclimatestudygroup.com/?page_id=683

Social Justice and Economics

Past: April 23rd, 2018: Monday, April 23rd, 1:30 – 3:00pm

Behavioral Economics and the Prospects of a New Economic System Based on Wellbeing

BY: Prof. Paul Sutton, DU Dept. of Geography and the Environment Paul Sutton

Slides and links:

- Presentation – PowerPoint: [Sutton_Toward_A_Sustainable_Wellbeing_Economy](#)
- Presentation – PDF: [Sutton_Toward_A_Sustainable_Wellbeing_Economy](#)
- Handouts:
 - 2018.04.23p Assessing Human and Ecological Wellbeing for Colorado concept paper
 - 2018.04.23 Half-page Doughnut Economics Models
- Links:
 - **Kate** Raworth: Donut Economics video: Why it's time for 'Doughnut Economics' | **Kate** Raworth | TEDxAthens: <https://www.youtube.com/watch?v=1BHOfIzxPjI&feature=youtu.be>
 - **Kate** Raworth homepage (TEDtalk and doughnut model): . : <https://www.kateraworth.com/doughnut/>
 - A good life for all within planetary boundaries; O'Neill et al.: [nature.com/articles/O'NEILL ET AL.](https://www.nature.com/articles/O'NEILL_ET_AL)
 - Related; allow interactive comparison of countries to one another: <https://goodlife.leeds.ac.uk/>
 - <https://www.nationalreview.com/corner/environmentalists-push-global-wealth-redistribution/>

Monday January 14th.

REGENERATIVE ECONOMICS AND COLORADO OPPORTUNITIES

SPEAKER: HUNTER LOVINS, President & Founder, Natural Capitalism Solutions

SLIDES: [Hunter Lovins20190114OPT – PDF](#)

WHERE: Library Portico, Iliff School of Theology (2323 E. Iliff Ave.)

SPONSORED BY: Ethics and Ecological Economics (EEE) Forum

"Humanity's collision with planetary boundaries requires a radical rethink of economic theory and practice." –*A Finer Future: Economics in Service to Life* (2018)

Solutions

How to Overcome our Inertia and Apathy



APATHY / INERTIA

WHY?

- IT'S too late
- It's too big a problem
- It's up to the government
- I'm not long for here anyway
- It's too expensive
- I'm too busy



<https://eos.org/articles/climate-scientists-new-hurdle-overcoming-climate-change-apathy>

APATHY / INERTIA vs. good motives:

- IT'S our planet
- It's the right thing to do
- I CARE FOR FUTURE GENERATIONS!
- It's for our grandkids, or dogs or cats 😊
- I believe in promoting the best of human values by example



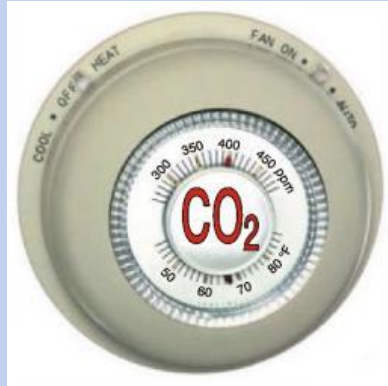
<https://eos.org/articles/climate-scientists-new-hurdle-overcoming-climate-change-apathy>

SOLUTIONS TO APATHY

CHANGE OUR WAY OF THINKING

Earth in human hands

- Kerry Emanuel, MIT Prof. Meteorology:
- “...there are few, if any, historical examples of civilizations consciously making sacrifices on behalf of descendants two or more generations removed”
- NEEDED CABINET POSTION:
 - **Secretary of the future**



Human
Activity

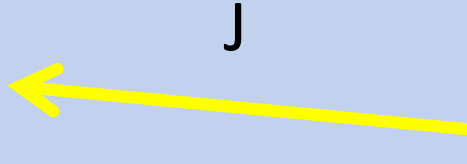


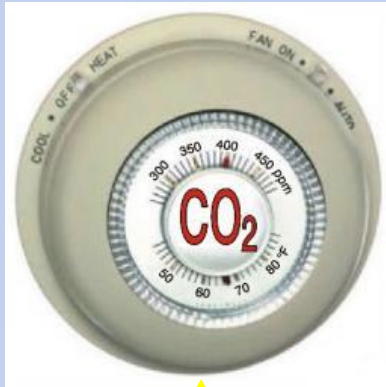
Warmer Air,
Warmer Water
(Global Warming)

More Water Vapor
and Clouds



Atmosphere
Biosphere
Hydrosphere
Cryosphere
(Climate Change)





More Water Vapor
and Clouds

Warmer Air,
Warmer Water
(Global Warming)

Atmosphere
Biosphere
Hydrosphere
Cryosphere
(Climate Change)

HUMAN RESPONSES

Personal
Family, Friends, Neighbors
Town and City
State
National
International

CRES YouTube Channel:

<https://www.youtube.com/channel/UCr81EUb2qVJVfmmlJMXEHVw/videos>



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Responding to Climate Change - Phil Nelson, CCL
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James Balog: Fighting Fracking is Patriotic
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Bill McKibben: Fight Fracking, Fight for the Planet
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Northern Colorado Clean Cities Coalition | Presentati...
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Net Zero Homes: Why it's easy to build one now!
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Sparking the EV Transition: A Policy Toolkit for Local...
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The Republican Case for Action on Climate - Claudin...
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The Race to Zero Carbon - Chuck Kutscher
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Mini-Split Heat Pumps: Hot (and Cool) Solutions for...
593 views • 5 months ago



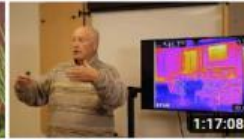
How They Built A Net Zero Church. A success story.
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Decarbonizing Colorado's Energy Economy - Sierra...
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Paths to Sustainability in Daily Life - Part 2 - Steve...
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PRPA's Renewable Resource Plan
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Affordable Home Energy: The work of Energy Outreach...
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Optimizing Battery Sizing To Maximize Economic Return ...
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Catalyzing Emission-Free Cities. Michael Totten
178 views • 7 months ago



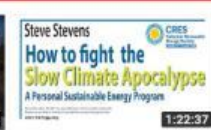
Better Living Beyond Fossil Fuels | Presentation by Brent Nelson, NREL
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Addressing Climate Change at a Local Level | Panel Discussion with Brad Smith
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Addressing Climate Change at a Local Level | Brad Smith
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How to fight the Slow Climate Apocalypse? A Personal Sustainable Energy Program
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The Energy-Water-Land Nexus. Brent Nelson, NREL
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Commercial Innovation for Building Efficiency - Panel Discussion with Sarah Kurtz
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Ditching Fossil Fuels: Colorado moves to 100% renewable energy
999 views • 11 months ago



Extreme Home Efficiency Makeover
311 views • 11 months ago



Drawdown: Ways out of the Climate Crisis. Paul Hawken
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Solar's Role Worldwide - Transitioning to 100% Renewable Energy
5K views • 1 year ago



Diversifying STEM - Dr. Tracy Camp
180 views • 1 year ago



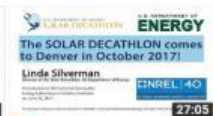
A New Era for Solar - Sarah Kurtz, PhD, NREL
15K views • 1 year ago



Can Hydrogen Save our Energy System? Mark Ruff
1.6K views • 1 year ago



The True Cost of Coal - 350 Colorado Springs
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The Solar Decathlon is coming to Denver!
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Tony Seba: Clean Disruption of Energy & Transportation
565K views • 1 year ago



Navigating Climate Change - A Communications Challenge
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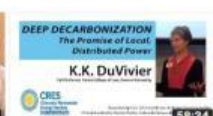
Banking on Lithium: Energy Storage Alternatives
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Why Public Science & Private Industry Go Hand In Glove ...
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Fracking - Too Dirty, too dangerous. Why Health...
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Deep Decarbonization: The Promise of Local, Distributed Power
599 views • 1 year ago



March For Science Denver 2017 - Slideshow
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NREL's Sustainable Energy Research 1977-2017
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Energy In Transition. NREL's David Mooney on...
1.7K views • 1 year ago



Progress in Solar Photovoltaics 2017 - Doug Vander Wilt
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Driverless Cars and the Environment - Rutt Bridges, NREL
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The Utility of the Future is Local. Boulder's...
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Cleantech 2020 & Beyond - Futurist Thomas Frey
2.7K views • 1 year ago



Bill Ritter - Powering Forward. The Clean Energy...
1K views • 1 year ago



Global Warming Demystified - Jeffrey Bennett
516 views • 1 year ago



Solar Wars 2017 & The Trump Effect - Bill Ellard
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Why Storage is Key for a Renewable Energy Future
7.4K views • 2 years ago



What's Happening in Corporate Renewables - Amy Haddon
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Clean Energy through Open Electricity Markets - Ken Regelson
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Bill Ritter: Moving Ahead in the Shifting Political...
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Wind Energy - Sandy Butterfield on its Evolution ...
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Extreme Weather & Climate Change - What's our...
56.1K views • 1 year ago



Ramping Up Solar to Power the World - Greg Wilson, NREL
1.06.12 views • 1 year ago



The State of the US Energy Transition - Chris Neider
1.09.59 views • 1 year ago



Where Are Hydrogen Fuel Cell Vehicles today? (October 2017)
1.01.32 views • 1 year ago



C-PACE Easy Financing for Energy Improvements for...
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NREL's Director Martin Keller on NREL's Role on Climate
20.18 views • 1 year ago

CKB **REEEP** **NREL**
GETTING CLIMATE KNOWLEDGE OUT
 William (Bill) Becker, executive director of the Center for Climate Knowledge Brokers
 Robert J. (Bob) Neven, senior advisor to the director of the Center for Climate Knowledge Brokers
 Chuck Becker, executive director of the Center for Climate Knowledge Brokers
 Joshua Applegate, executive director of the Center for Climate Knowledge Brokers
 Period: October 15-20, 2011 at NREL, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
52:45

Getting Climate Knowledge Out
 55 views • 2 years ago

CKB **REEEP** **NREL**
CLIMATE KNOWLEDGE BROKERS MANIFESTO
 Florian Bauer
 Head of the NREL Climate Knowledge Brokers
 November 28, 2014 at NREL, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
9:32

The Climate Knowledge Brokers Manifesto - Florian...
 55 views • 2 years ago

CKB **REEEP** **NREL**
HUNTER LOVINS Communicating Climate Issues
 Interview with Bill Becker
 November 28, 2014 at NREL, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
43:07

Hunter Lovins & Bill Becker: Communicating Climate...
 179 views • 2 years ago

CKB **REEEP**
NREL
Victoria Healey, NREL Assisting Countries with Clean Energy Policy
 Clean Energy SOLUTIONS CENTER
 April 24, 2014 at NREL, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
10:00

How NREL helps establishing Clean Energy Worldwide
 34 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Maggie Fox SEEDING CLIMATE CHANGE Lessons from Al Gore's Climate Reality Project
 A Talk & Conversation with Bill Becker
 Office: October 22, 2014 at CRES, Golden, Colorado
 Hosted and edited by: CRES, Golden, Colorado
1:27:53

Maggie Fox: Seeding Climate Action (w. Bill Becker)
 103 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Morgan Law Passive House Design
 Architect Morgan Law is a proponent of Passive House design. He is a member of the Colorado Renewable Energy Society.
 Presented by: Morgan Law
 Hosted and edited by: Morgan Law
39:39

Why a Hair Dryer Can Heat Your Passive House - Morg...
 1.7K views • 2 years ago

CRES **Colorado Renewable Energy Society**
J David McNeil The History of Electric Cars
 Mr. McNeil is a former member of the Colorado Renewable Energy Society and a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 Page 18, 2014
 Hosted and edited by: NREL, Golden, Colorado
23:32

The History of Electric Cars - J David McNeil
 342 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Jim Smith Why Gas powered Cars are Obsolete
 "If the world's oil supply runs out, we will have to find a way to power our cars. The only way to do that is to use electricity. Gasoline powered cars are obsolete."
 Hosted by the Office of the Colorado Renewable Energy Society
 Page 11, 2014
 Hosted and edited by: NREL, Golden, Colorado
35:33

Why Gasoline Powered Cars Are Obsolete - Jim Smith
 47K views • 2 years ago

Dr. Joseph Roman Climate Change Solutions Everything you thought you know about Climate Change is Obsolete
 November 28, 2014 at NREL, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
52:13

Climate Change Solutions : What you thought you knew...
 35K views • 2 years ago

Molly May Natural Gas Resources
 Molly May is a PhD student at the University of Colorado Boulder and a research fellow at the Center for Global Energy Policy.
 Hosted by: Molly May
 Hosted and edited by: Molly May
1:00:09

Natural Gas Resources - Clean, Cheap, & Abundant?
 198 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Ethan Palay BUILDING A TINY HOUSE Students at CSM and UCD aim for the 2019 Solar Decathlon
 Ethan Palay is a PhD student at the University of Colorado Boulder and a research fellow at the Center for Global Energy Policy.
 Hosted by: Ethan Palay
 Hosted and edited by: Ethan Palay
18:49

Building a Tiny House for the Solar Decathlon
 151 views • 2 years ago

CRES **Colorado Renewable Energy Society**
CHRISTOPH STEFES Germany's Energy Transition How Citizens' Power Created Clean Power
 Christoph Stefes, PhD, is a research fellow at the Center for Global Energy Policy at the University of Colorado Boulder, and a senior partner at the consulting firm, Energy Analysts, in Berlin, Germany.
 Hosted by the Office of the Colorado Renewable Energy Society
 August 25, 2014 in Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
55:58

Germany's Energy Transition (Christoph Stefes - 4/28/16)
 860 views • 2 years ago

CRES **Colorado Renewable Energy Society**
KRISTINA SICKLES Grid Alternatives and Accessible, Affordable Solar
 Kristina Sickles is a Development Director at NREL. She is a member of the Colorado Renewable Energy Society and a long-time clean energy and electric vehicle advocate. She gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 Page 18, 2014
 Hosted and edited by: NREL, Golden, Colorado
15:54

GRID Alternatives: Accessible, Affordable Sola...
 98 views • 2 years ago

Kevin Trenberth, NCAR FIFTY SHADES OF CLIMATE CHANGE
 Dr. Kevin Trenberth is a senior scientist at NCAR. He is a member of the Colorado Renewable Energy Society and a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 Page 18, 2014
 Hosted and edited by: NREL, Golden, Colorado
37:35

Fifty Shades of Climate Change (Kevin Trenberth,...
 776 views • 2 years ago

BOB INGLIS ENGAGING CONSERVATIVES ON CLIMATE CHANGE
 Bob Inglis is a former Republican Congressman and a member of the Colorado Renewable Energy Society. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 Page 18, 2014
 Hosted and edited by: NREL, Golden, Colorado
37:25

Engaging Conservatives on Climate Change (Bob Inglis ...
 216 views • 2 years ago

CRES **Colorado Renewable Energy Society**
THE ENERGY WATER NEXUS Choices in Energy Generation JORDAN MACKNICK, NREL
 Jordan Macknick is an Energy Engineer and Environmental Analyst with the Energy Efficiency & Modeling Division in the Energy Systems Analysis Center at the National Renewable Energy Laboratory (NREL) and leads NREL's energy water nexus research program.
 Hosted by the Office of the Colorado Renewable Energy Society
 March 14, 2014 at CRES, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
1:07:13

The Energy Water Nexus (Jordan Macknick,...
 193 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Erin Overturf REINING IN CARBON The EPA's Clean Power Plan
 Erin Overturf is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. She is a long-time clean energy and electric vehicle advocate. She gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 March 14, 2014 at CRES, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
1:04:05

Reining in Carbon: The EPA's Clean Power Plan (Erin...
 99 views • 2 years ago

CRES **Colorado Renewable Energy Society**
RON BINZ How to End our Utilities' Love Affair with Fossil Fuel
 Ron Binz is a former chair of the Colorado Public Utilities Commission (PUC) and a senior partner at the consulting firm, Energy Analysts, in Berlin, Germany.
 Hosted by the Office of the Colorado Renewable Energy Society
 March 14, 2014 at CRES, Golden, Colorado
 Hosted and edited by: NREL, Golden, Colorado
27:30

How to End our Utilities' Love Affair with Fossil Fuel (Ron...
 57 views • 2 years ago

CRES **Colorado Renewable Energy Society**
Kathleen Coulter The Current State of Solar Energy for Low Income Consumers
 Kathleen Coulter is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. She is a long-time clean energy and electric vehicle advocate. She gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
31:53

The Current State of Solar Energy for Low Income...
 65 views • 3 years ago

Ken Regelson, 100% Renewables: Let's Go!
 Ken Regelson is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
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26:54

100% Renewables: Let's Go! (Ken Regelson - 2/6/16)
 116 views • 3 years ago

NCRE Energy Innovation Forum (1/19/16)
 NCRE Energy Innovation Forum (1/19/16)
 Hosted by the Office of the Colorado Renewable Energy Society
 January 19, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
1:22:20

NCRE Energy Innovation Forum (1/19/16)
 62 views • 3 years ago

CRES **Colorado Renewable Energy Society**
Denver's Sustainability Progress (Jerry Tinianow ...)
 Jerry Tinianow is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
45:47

Denver's Sustainability Progress (Jerry Tinianow ...
 44 views • 3 years ago

Rebecca Cantwell, Solar Thermal and Rural Markets Showroom Project
 Rebecca Cantwell is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. She is a long-time clean energy and electric vehicle advocate. She gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
32:48

Solar Power in Colorado (Rebecca Cantwell ...
 209 views • 3 years ago

Dr. Howard Geller, Energy Efficiency in Colorado
 Dr. Howard Geller is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
1:04:04

Energy Efficiency in Colorado (Dr. Howard Geller - 9/24/15)
 122 views • 3 years ago

Climate Change, Sustainability, and Arctic an...
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
57:38

Climate Change, Sustainability, and Arctic an...
 2K views • 3 years ago

Steve Stevens, Beyond Net Zero
 Steve Stevens is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
58:41

Beyond Net Zero (Steve Stevens - 9/23/15)
 607 views • 3 years ago

Dr. Chuck..., Climate Change: What We Can Do About It
 Dr. Chuck... is a senior advisor at the Center for Global Energy Policy at the University of Colorado Boulder. He is a long-time clean energy and electric vehicle advocate. He gives a history of electric cars and how they have evolved over time.
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
1:07:59

Climate Change: What We Can Do About It (Dr. Chuck...
 4.4K views • 3 years ago

Colorado Renewable Energy Society: 15 Years of...
 Hosted by the Office of the Colorado Renewable Energy Society
 February 9, 2016 at the University of Colorado Boulder
 Hosted and edited by: NREL, Golden, Colorado
14:57

Colorado Renewable Energy Society: 15 Years of...
 60 views • 4 years ago

CRES YouTube Channel:

<https://www.youtube.com/channel/UCr81EUb2qVJVfmmlJIMxEHVw/videos>

- Tony Seba: Clean Disruption - Energy & Transportation
 - <https://youtu.be/2b3ttqYDwF0>
- Ramping Up Solar to Power the World - Greg Wilson, NREL
 - <https://youtu.be/7CDPHxcnq4c>
- Driverless Cars and the Environment - Rutt Bridges, Futurist
 - <https://youtu.be/0BWJcpesr6A>
- Bill Ritter - Powering Forward. The Clean Energy Revolution can't be stopped
 - <https://youtu.be/agowW1Qkwms>
- Drawdown: 60 Minutes with Paul Hawken
 - <https://www.youtube.com/watch?v=4XrFnK1RrLE>
- Can Hydrogen Save our Energy System Mark Ruth, NREL
 - <https://www.youtube.com/watch?v=4u93y-l0cwM&t=199s>
- 100% Renewables: Let's Go! (Ken Regelson - 2/6/16)
 - <https://youtu.be/xDBPE6ZUGXQ>
- Why Storage is Key for a Renewable Energy Future
 - https://youtu.be/Yc_hULwykvQ

Colorado Renewable Energy Society

– YouTube of selected talks:

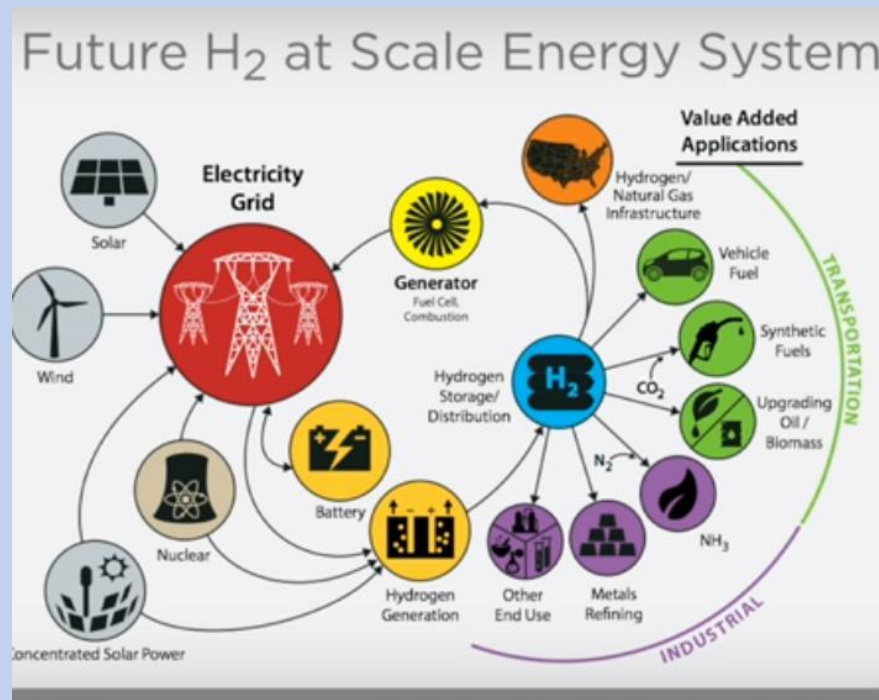
ON Hydrogen:

Ramping Up Solar to Power the World - Greg Wilson, NREL:

<https://www.youtube.com/watch?v=7CDPHxcnq4c>

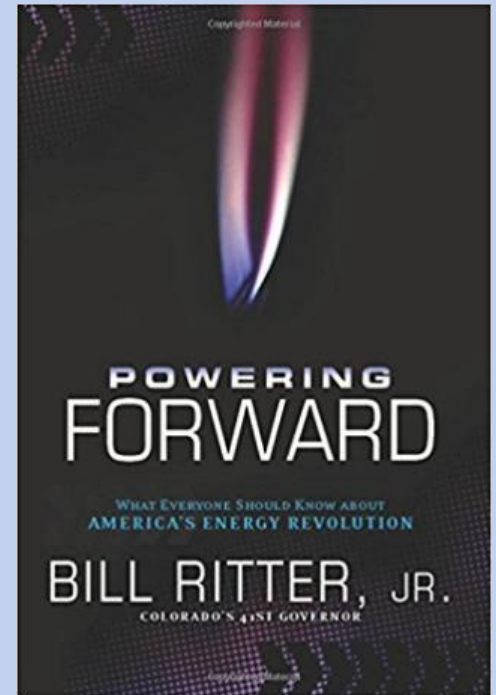
Can Hydrogen Save our Energy System? Mark Ruth, NREL

<https://www.youtube.com/watch?v=4u93y-10cwM>



Powering Forward: ...America's Energy Revolution

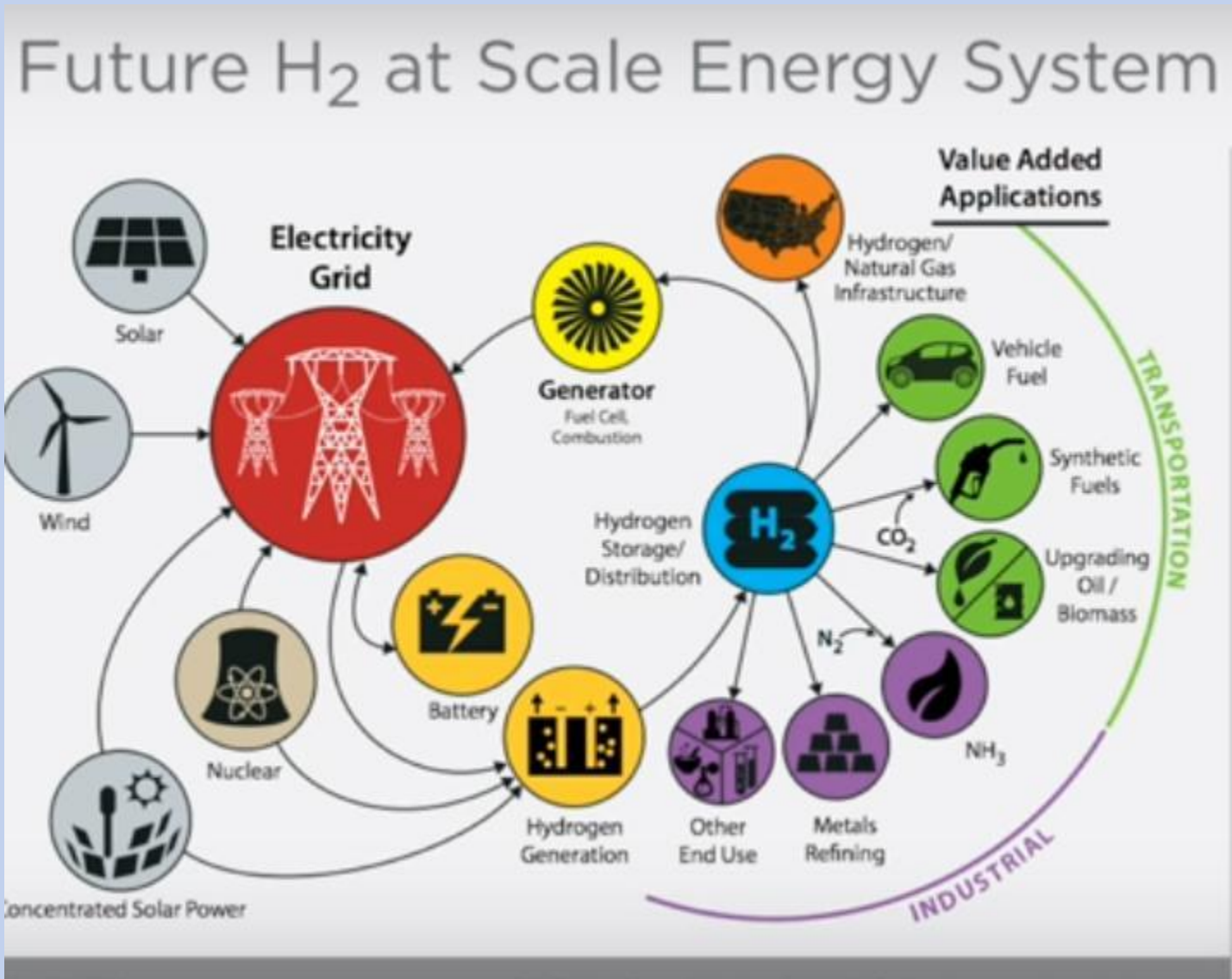
- A historic energy revolution is underway in the United States & THE WORLD:
 - Wind, sunlight, and other sustainable resources
 - Power plants on their roofs
 - Entire communities are switching to 100 percent renewable energy; Hawaii has such a commitment!
 - Urgent need to prevent climate change is causing people around the planet to question their reliance on carbon-intensive oil, coal, and natural gas.



Ken Regelson links

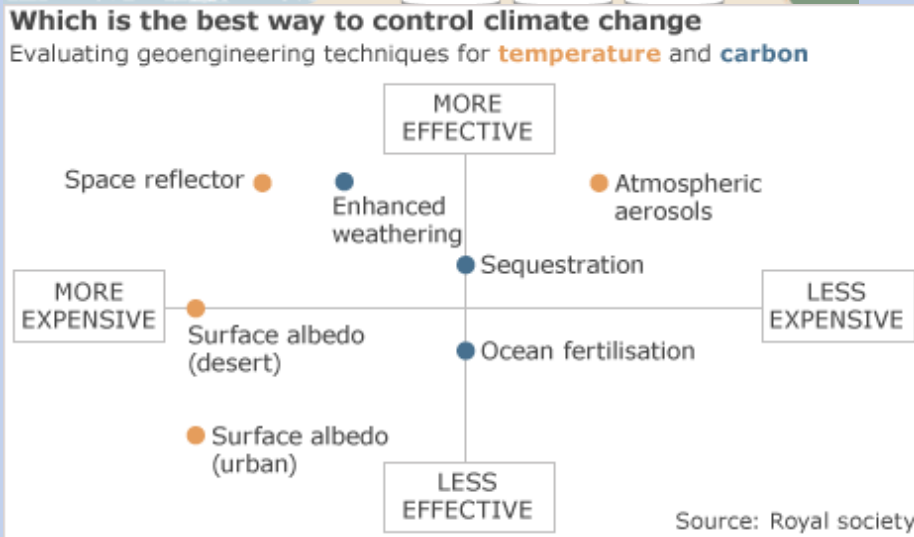
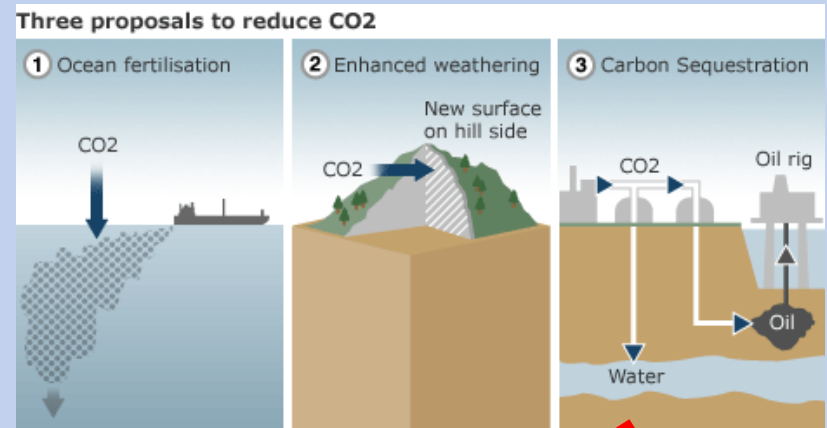
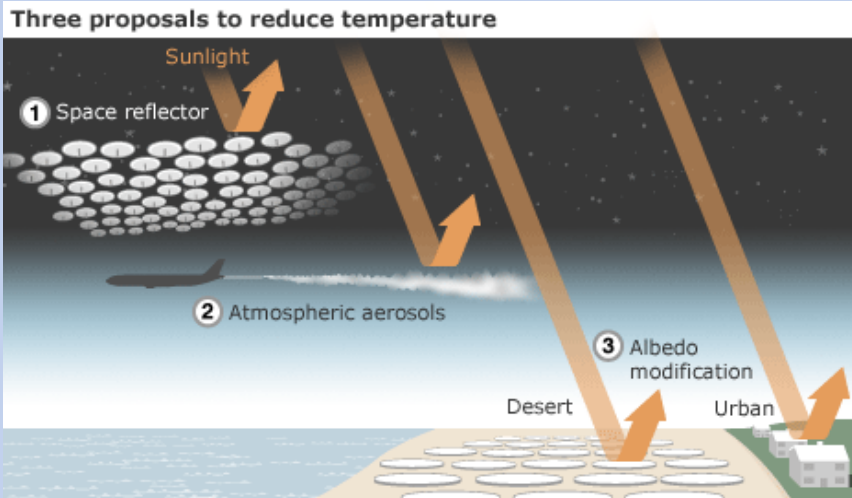
- EnergyFreedomCO.org
- Innovation and lower costs through competition.
-
- EnergyShouldBe.org
- 100% Renewables

When you have excess power:



Geoengineering

Solar Radiation Management vs. Carbon dioxide Removal (SRM VS. CDR)



Biochar & Beccs

- <https://en.wikipedia.org/wiki/Biochar>
- https://en.wikipedia.org/wiki/Bio-energy_with_carbon_capture_and_storage

Royal Society

Additional

- **SRM – Solar Radiation Management**
 - Cloud Brightening to increase Earth's Albedo (reflectivity) also investigated
- **CDR – Carbon Dioxide Removal (carbon negativity)**
 - Ocean fertilization with Iron to create algal blooms that sink to the sea floor:
 - https://en.wikipedia.org/wiki/Ocean_fertilization
 - Enhanced weathering: taking unstable mantle minerals, particularly Olivine to lock up Carbon
https://en.wikipedia.org/wiki/Enhanced_weathering
 - Carbon Sequestration often ignores the potential of Biochar
 - Carbon Sequestration synonymous with Carbon Negativity

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**ELDERS
CLIMATE
ACTION**

A project of Elders Action Network

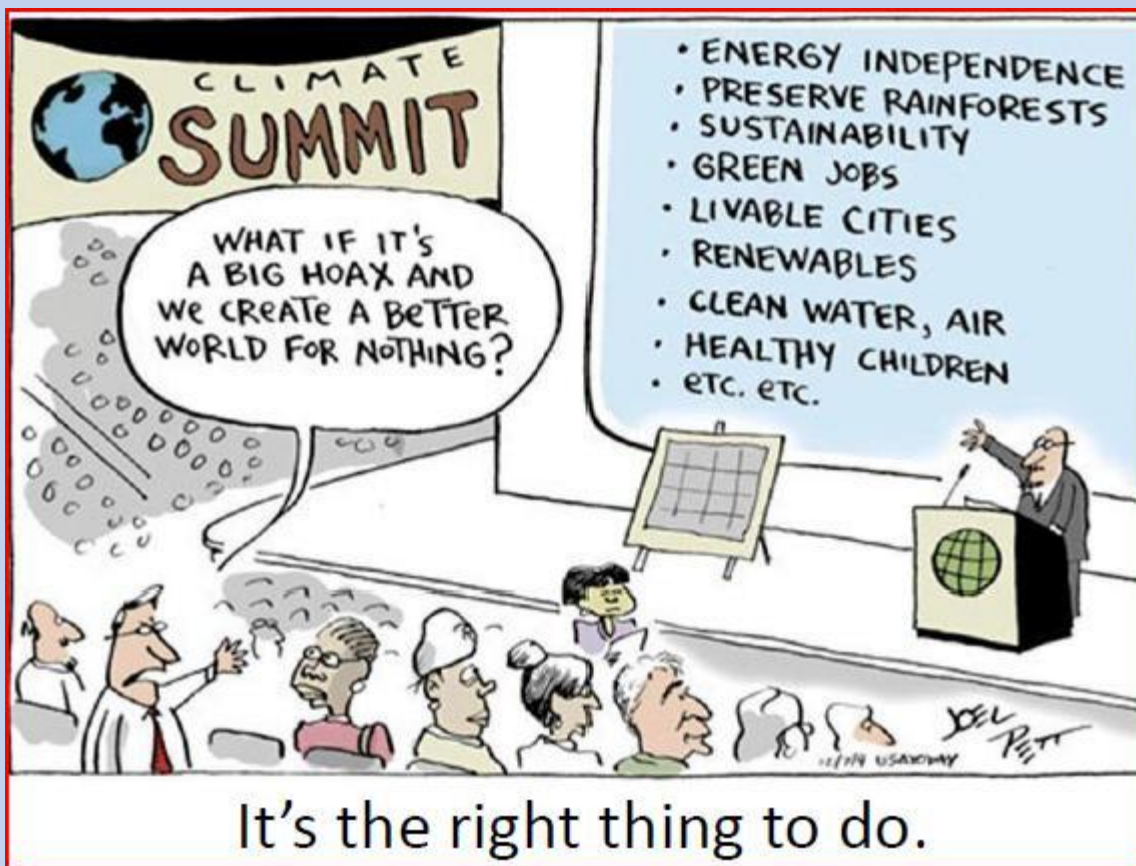
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<https://www.eldersclimateaction.org/>



https://www.skepticalscience.com/2019-SkS-Weekly-Digest_07.html



How does one respond to Deniers of climate change?

With Simple Facts and Logic

- **1. Is climate changing? YES**
 - Scientific
- **2. Do people have anything to do with it? YES**
 - Greenhouse gas emissions (primarily carbon dioxide from fossil fuel burning) have to warm the atmosphere—it is what they do.
- **3. Is climate change bad? YES**
 - ...change in the environment of stable civilizations is disruptive to those civilizations....
 - Alterations in areas in which crops can be grown... when leaves fall, when insects emerge, etc.), ...
 - Shifting storm tracks, and rising sea level may have devastating economic, social, and political consequences on modern societies.
 - Ocean Acidification
- **4. Can we do anything about it? YES**
 -cessation of emissions can stabilize climate in the 21st century....
- **5. Is it worth doing anything about? YES**
 - Economic analyses

WHAT TO DO?

- PLEASE **QUESTION MOTIVES** IF ONE SAYS:
“Well I’m not really sure how much is man-made”
- AND **ASK** or think about their credentials!
 - **Are they climate scientists?**
- AND Don’t spend too much time (waste?) expecting to change world views

Web Links on Climate

- <https://skepticalscience.com/>
 - <https://skepticalscience.com/denial101x-videos-and-references.html>
- <http://www.realclimate.org/>
- <http://climatecentral.org/>
- <https://climate.nasa.gov/> <https://climate.nasa.gov/causes/> , etc.
- Jeffrey Bennett: <http://www.globalwarmingprimer.com/tour/>
 - <http://www.globalwarmingprimer.com/primer/primer4/>
- Jeff Masters/Weather underground: <https://www.wunderground.com/weather-infographics/climate-change-today>
 - <https://www.wunderground.com/blog/JeffMasters/show.html>
- <http://www.nationalgeographic.com/magazine/2017/04/seven-things-to-know-about-climate-change/>
- Extreme Weather: Phil Nelson:
<https://www.youtube.com/watch?v=gQ1kPMYCFEY&t=9s>

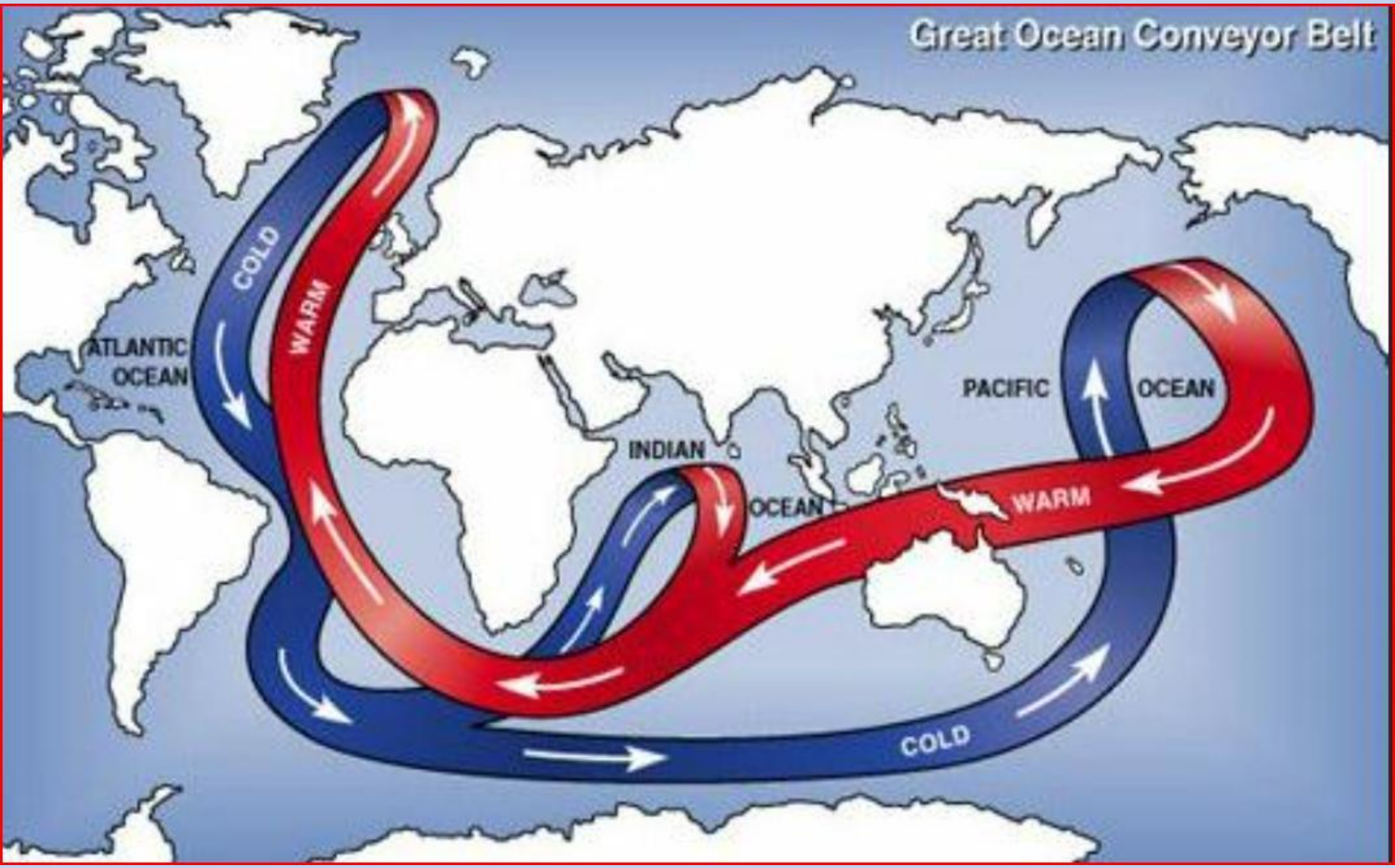
Wallace Broecker, Climate Scientist Who Popularized Term 'Global Warming,' Dies at 87

By Associated Press · 2 days ago · weather.com



<https://weather.com/news/news/2019-02-18-wally-broecker-dies-global-warming>

Great Ocean Conveyor Belt

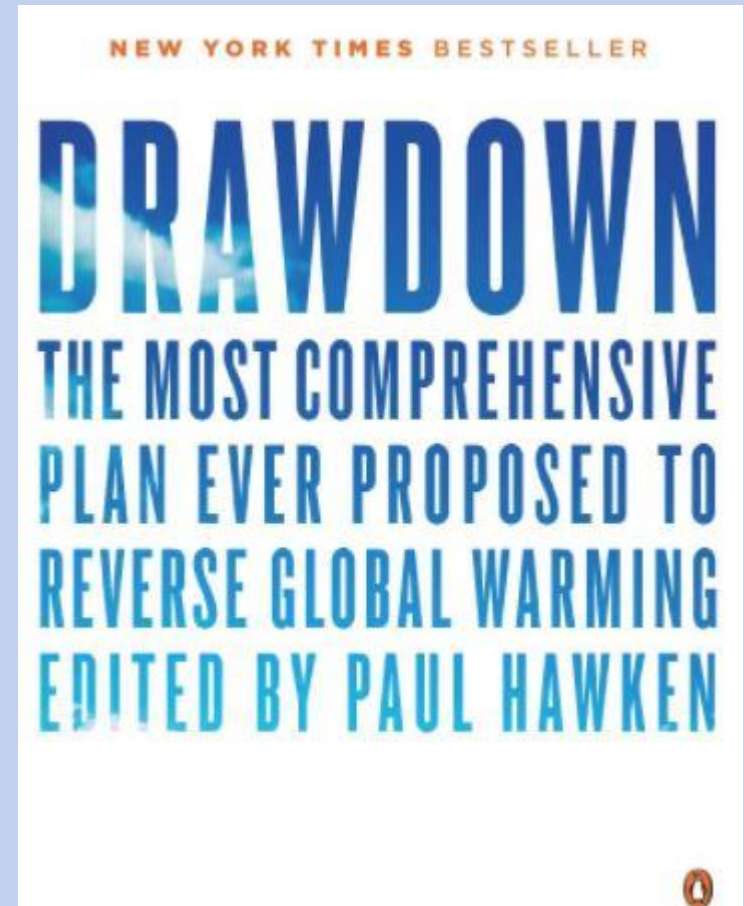
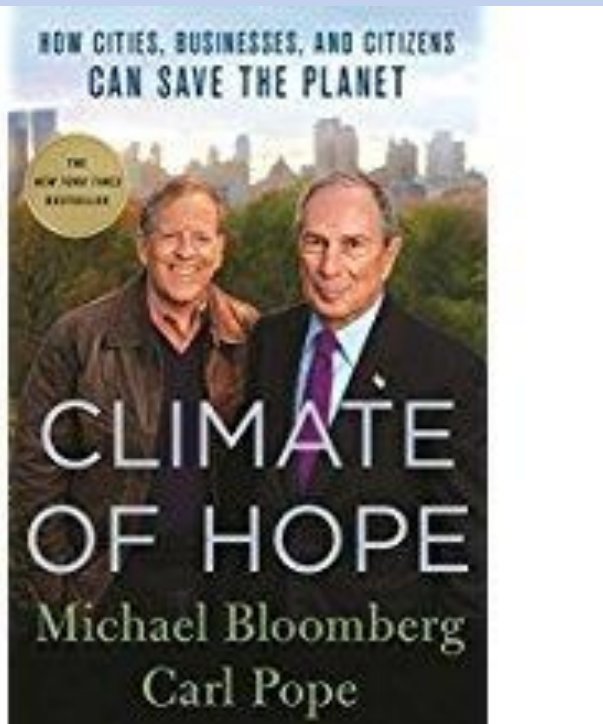


WALLY BROECKER

11/29/1931-2/18/2019

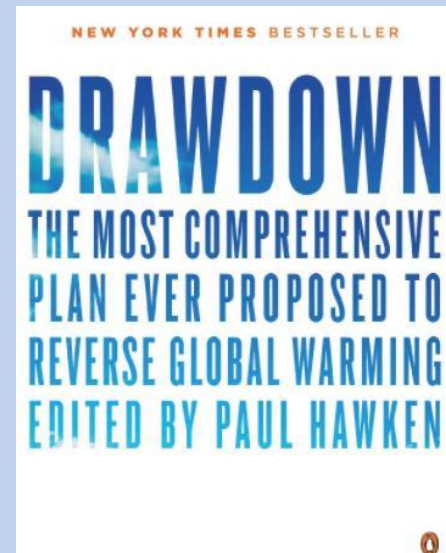
- https://en.wikipedia.org/wiki/Wallace_Smith_Broecker
- <https://weather.com/news/news/2019-02-18-wally-broecker-dies-global-warming>
- Wally Broecker's ebook – [What Drives Glacial Cycles Broecker](#)
- Wally Broecker's 1975 paper [BroeckerScience1975](#)
[Are we on the brink of a pronounced GLOBAL WARMING](#)

- **READ:**
Climate of Hope – Solutions
Drawdown – and associated web
pages



Drawdown

- A Critique:
 - DOES NOT DEAL ENOUGH WITH CARBON NEGATIVITY –
 - Rather – mostly about carbon emission reduction; we need more than that – i.e. carbon negativity too to take out the excess we've put in
 - To reduce the heating/extreme weather events
 - To slow/stop Ocean Acidification



Summary of Solutions by Overall Rank

- <http://www.drawdown.org/solutions-summary-by-rank>

Rank	Solution	Sector	TOTAL ATMOSPHERIC CO ₂ -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	59.60	N/A	N/A
7	Family Planning	Women and Girls	59.60	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
11	Regenerative Agriculture	Food	23.15	\$57.22	\$1,928.10
12	Temperate Forests	Land Use	22.61	N/A	N/A
13	Peatlands	Land Use	21.57	N/A	N/A
14	Tropical Staple Trees	Food	20.19	\$120.07	\$626.97
15	Afforestation	Land Use	18.06	\$29.44	\$392.33
16	Conservation Agriculture	Food	17.35	\$37.53	\$2,119.07
17	Tree Intercropping	Food	17.20	\$146.99	\$22.10
18	Geothermal	Electricity Generation	16.60	\$-155.48	\$1,024.34
19	Managed Grazing	Food	16.34	\$50.48	\$735.27
20	Nuclear	Electricity Generation	16.09	\$0.88	\$1,713.40

Summary of Solutions by Overall Rank

- <http://www.drawdown.org/solutions-summary-by-rank>

21	Clean Cookstoves	Food	15.81	\$72.16	\$166.28
22	Wind Turbines (Offshore)	Electricity Generation	14.10	\$572.40	\$274.57
23	Farmland Restoration	Food	14.08	\$72.24	\$1,342.47
24	Improved Rice Cultivation	Food	11.34	N/A	\$519.06
25	Concentrated Solar	Electricity Generation	10.90	\$1,319.70	\$413.85
26	Electric Vehicles	Transport	10.80	\$14,148.00	\$9,726.40
27	District Heating	Buildings and Cities	9.38	\$457.10	\$3,543.50
28	Multistrata Agroforestry	Food	9.28	\$26.76	\$709.75
29	Wave and Tidal	Electricity Generation	9.20	\$411.84	\$-1,004.70
30	Methane Digesters (Large)	Electricity Generation	8.40	\$201.41	\$148.83
31	Insulation	Buildings and Cities	8.27	\$3,655.92	\$2,513.33
32	Ships	Transport	7.87	\$915.93	\$424.38
33	LED Lighting (Household)	Buildings and Cities	7.81	\$323.52	\$1,729.54
34	Biomass	Electricity Generation	7.50	\$402.31	\$519.35
35	Bamboo	Land Use	7.22	\$23.79	\$264.80
36	Alternative Cement	Materials	6.69	\$-273.90	N/A
37	Mass Transit	Transport	6.57	N/A	\$2,379.73
38	Forest Protection	Land Use	6.20	N/A	N/A
39	Indigenous Peoples' Land Management	Land Use	6.19	N/A	N/A
40	Trucks	Transport	6.18	\$543.54	\$2,781.63

Summary of Solutions by Overall Rank

- <http://www.drawdown.org/solutions-summary-by-rank>

41	Solar Water	Electricity Generation	6.08	\$2.99	\$773.65
42	Heat Pumps	Buildings and Cities	5.20	\$118.71	\$1,546.66
43	Airplanes	Transport	5.05	\$662.42	\$3,187.80
44	LED Lighting (Commercial)	Buildings and Cities	5.04	\$-205.05	\$1,089.63
45	Building Automation	Buildings and Cities	4.62	\$68.12	\$880.55
46	Water Saving - Home	Materials	4.61	\$72.44	\$1,800.12
47	Bioplastic	Materials	4.30	\$19.15	N/A
48	In-Stream Hydro	Electricity Generation	4.00	\$202.53	\$568.36
49	Cars	Transport	4.00	\$-598.69	\$1,761.72
50	Cogeneration	Electricity Generation	3.97	\$279.25	\$566.93
51	Perennial Biomass	Land Use	3.33	\$77.94	\$541.89
52	Coastal Wetlands	Land Use	3.19	N/A	N/A
53	System of Rice Intensification	Food	3.13	N/A	\$677.83
54	Walkable Cities	Buildings and Cities	2.92	N/A	\$3,278.24
55	Household Recycling	Materials	2.77	\$366.92	\$71.13
56	Industrial Recycling	Materials	2.77	\$366.92	\$71.13
57	Smart Thermostats	Buildings and Cities	2.62	\$74.16	\$640.10
58	Landfill Methane	Buildings and Cities	2.50	\$-1.82	\$67.57
59	Bike Infrastructure	Buildings and Cities	2.31	\$-2,026.97	\$400.47
60	Composting	Food	2.28	\$-63.72	\$-60.82

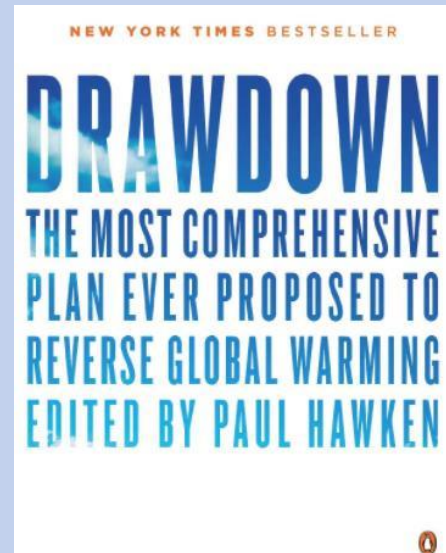
Summary of Solutions by Overall Rank

- <http://www.drawdown.org/solutions-summary-by-rank>

61	Smart Glass	Buildings and Cities	2.19	\$932.30	\$325.10
62	Women Smallholders	Women and Girls	2.06	N/A	\$87.60
63	Telepresence	Transport	1.99	\$127.72	\$1,310.59
64	Methane Digesters (Small)	Electricity Generation	1.90	\$15.50	\$13.90
65	Nutrient Management	Food	1.81	N/A	\$102.32
66	High-speed Rail	Transport	1.52	\$1,038.42	\$368.10
67	Farmland Irrigation	Food	1.33	\$216.16	\$429.67
68	Waste-to-Energy	Electricity Generation	1.10	\$36.00	\$19.82
69	Electric Bikes	Transport	0.96	\$106.75	\$226.07
70	Recycled Paper	Materials	0.90	\$573.48	N/A
71	Water Distribution	Buildings and Cities	0.87	\$137.37	\$903.11
72	Biochar	Food	0.81	N/A	N/A
73	Green Roofs	Buildings and Cities	0.77	\$1,393.29	\$988.46
74	Trains	Transport	0.52	\$808.64	\$313.86
75	Ridesharing	Transport	0.32	N/A	\$185.56
76	Micro Wind	Electricity Generation	0.20	\$36.12	\$19.90
77	Energy Storage (Distributed)	Electricity Generation	N/A	N/A	N/A
77	Energy Storage (Utilities)	Electricity Generation	N/A	N/A	N/A
77	Grid Flexibility	Electricity Generation	N/A	N/A	N/A
78	Microgrids	Electricity Generation	N/A	N/A	N/A
79	Net Zero Buildings	Buildings and Cities	N/A	N/A	N/A
80	Retrofitting	Buildings and Cities	N/A	N/A	N/A
			1050.99	\$29,636.40	\$73,874.44

Colorado Renewable Energy Society – YouTube of selected talks:

- Drawdown CRES YouTube video: Drawdown: Ways out of the Climate Crisis. Paul Hawken, Chip Comins: <https://youtu.be/4XrFnK1RrLE>
- Other Drawdown links:
 - <http://www.drawdown.org/>
 - <http://www.drawdown.org/solutions>
 - <https://www.facebook.com/projectdrawdown>



OLLI Courses to Consider

- Phil Nelson – Extreme Weather
- Alec Tsoucatos – Steady state economics – when more is not enough
- Great Decision – Peter Lohaus & Jeff Pederson