

Contemporary Issues Regarding Climate Change and Solutions





Contemporary Issues Regarding Climate Change and Solutions

**Paul Belanger, Ph.D.,
Geologist/Paleoclimatologist**

Tuesday October 31st , 2017:

SOLUTIONS

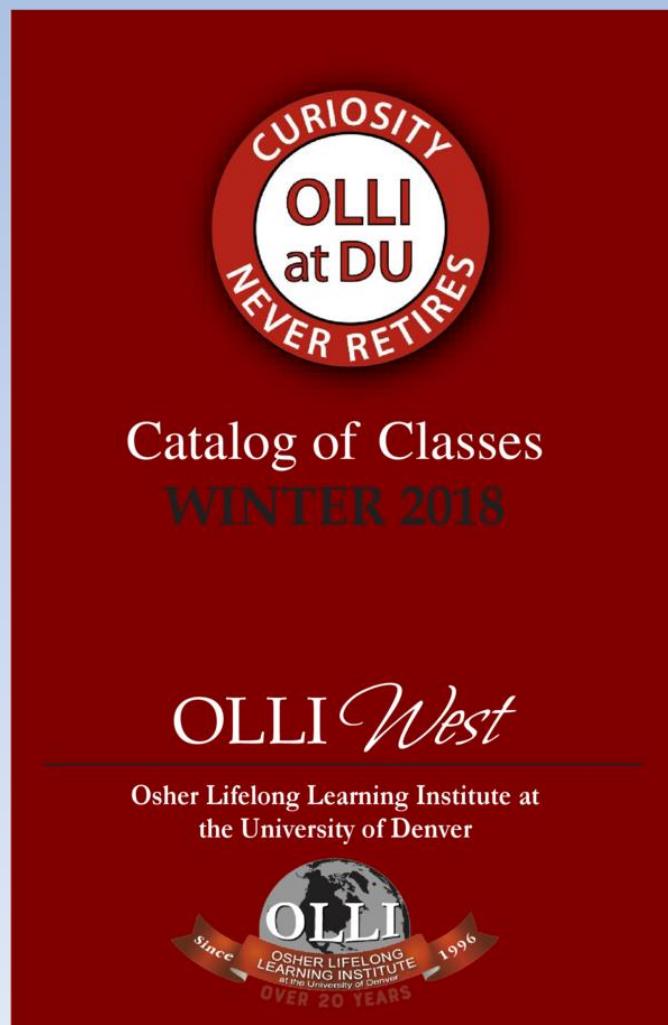
Contemporary Issues Regarding Climate Change and Solutions

Tuesday October 31ST , 2017:

- **Announcements**
- **Solutions**
 - **Energy: Conservation and De-carbonizing**
 - **Geoengineering:**
 - **Solar Radiation Management (SRM)**
 - **Carbon Dioxide Removal (CDR)**
 - **Local Government**
 - **Personal**

Announcements

- <http://files.constantcontact.com/5384ad7d001/e864e167-d221-43b3-8421-5eea93f9440e.pdf>



**Tuesday January 16th
through Monday
March 12th**

Announcements

- *OLLI West 10th Anniversary and Halloween Party Potluck*
- **TODAY**

Solutions: Energy

Colorado Renewable Energy Society

– YouTube of selected talks:

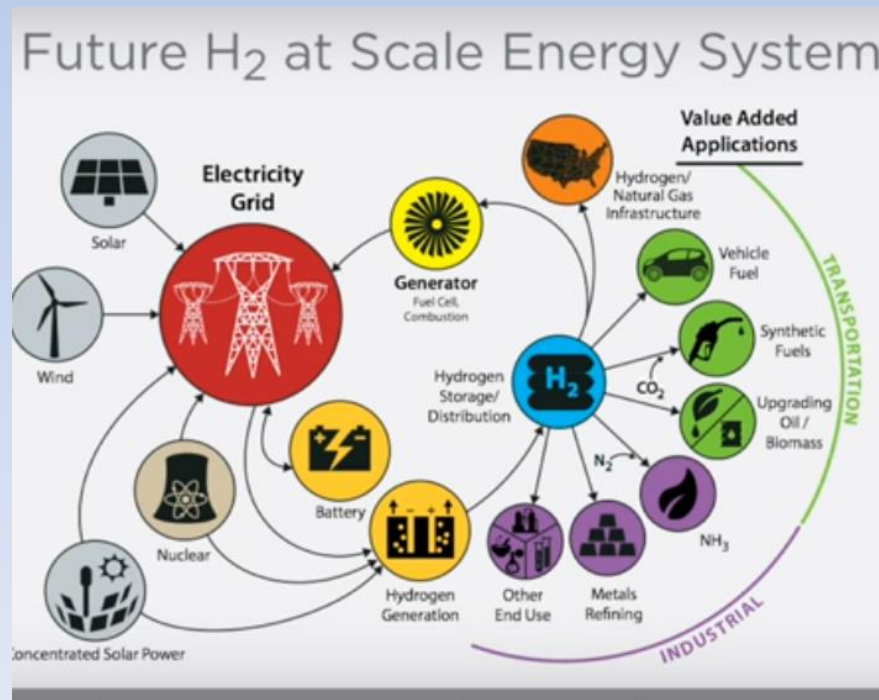
ON Hydrogen:

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-l0cwM>



Solutions: Geoengineering

Geoengineering:

1. Solar Radiation Management (SRM) and
2. Carbon Dioxide Removal (CDR) / Greenhouse Gas (GHG) Capture
 - Focus on: Biochar vs. Bio-Energy with Carbon Capture and Storage (BECCS) solutions
 - Direct Air Capture (DAR) also in this category
 - Reducing Enteric Methane (BURPED stomach gases from Ruminants) too
 - SEE MY BIOCHAR web page LINK:

Extras to investigate outside of class

SEE February 15, 2016 discussion on EEE tab:
http://denverclimatestudygroup.com/?page_id=683

- National Academy of Science (NAS) Climate Intervention: Preface and links ([Click here](#)); detailed reports below:
 - NATIONAL ACADEMY OF SCIENCES (NAS) ONLINE: **CLIMATE INTERVENTION: REFLECTING SUNLIGHT TO COOL EARTH** (2015), AT [HTTP://WWW.NAP.EDU/READ/18988](http://www.nap.edu/read/18988);
 - AND **CLIMATE INTERVENTION: CARBON DIOXIDE REMOVAL AND RELIABLE SEQUESTRATION** (2015), AT [HTTP://WWW.NAP.EDU/READ/18805](http://www.nap.edu/read/18805).

Terminology

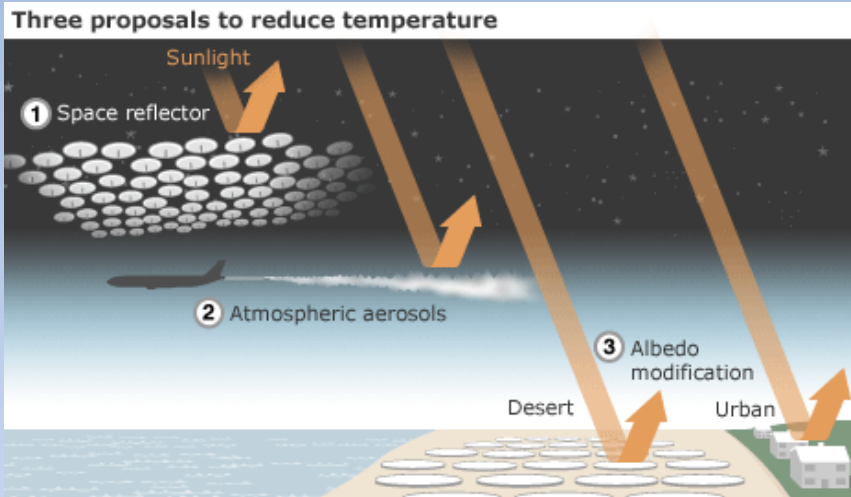
- No terminology is going to be complete
- Despite NAS efforts Geoengineering as a term is still currently the most common term used

Extras to investigate outside of class

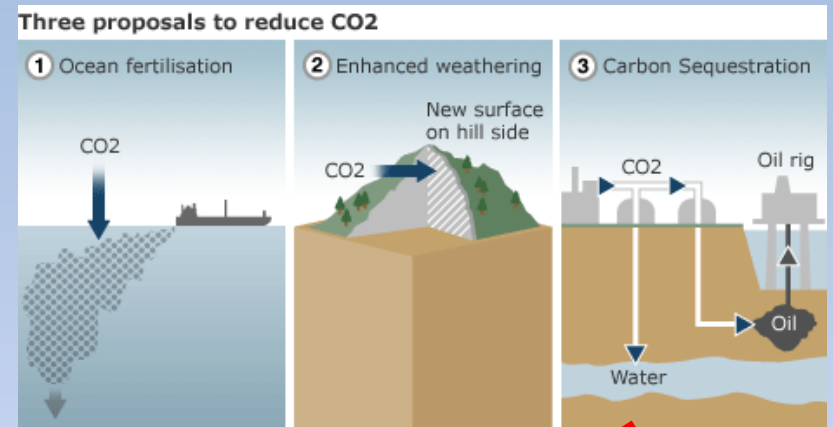
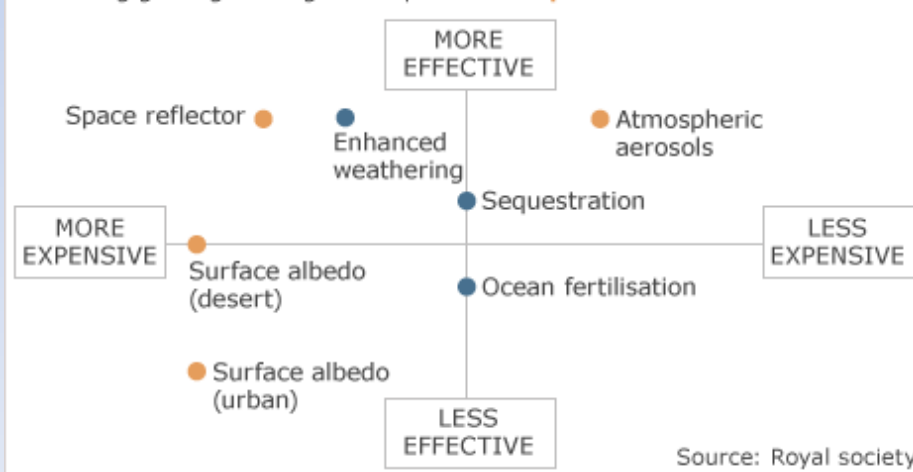
IPCC Assessment report-5 (AR5); Working Group III (WGIII): Mitigation

- [WGIII AR5 Presentation](#) or in [PDF format](#)
- [wg3 ar5 summary-for-policymakers approved](#)
- Video – the geoengineering dilemma 4.5 7.3 minutes
<https://www.futurelearn.com/courses/climate-change-challenges-and-solutions/1/steps/3297>
- Are Ideas to cool the planet realistic
<http://news.bbc.co.uk/2/hi/technology/8338853.stm>

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



Which is the best way to control climate change
Evaluating geoengineering techniques for **temperature** and **carbon**



Biochar & Beccs

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

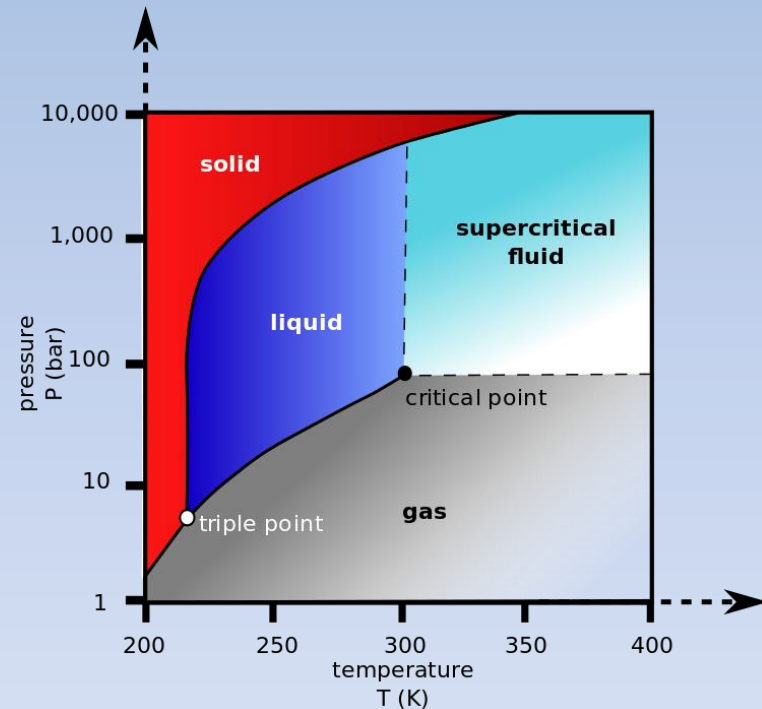
Royal Society

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

Supercritical CO₂

- See https://en.wikipedia.org/wiki/Supercritical_carbon_dioxide
- Miscible with salt water (saline aquifers)
- it can adopt properties midway between a [gas](#) and a [liquid](#). More specifically, it behaves as a [supercritical fluid](#) above its critical temperature (304.25 K, 31.10 °C, 87.98 °F) and critical pressure (72.9 atm, 7.39 MPa, 1,071 psi), expanding to fill its container like a [gas](#) but with a [density](#) like that of a [liquid](#).



Biochar

- Definition:

<https://en.wikipedia.org/wiki/Biochar>

- Biochar tab:

http://denverclimatestudygroup.com/?page_id=28



Left: usual Tropical soil; Right: Biochar soil (hundreds of years old)



Carbon Dioxide Removal (CDR)



Left: usual Tropical soil; Right: Biochar soil (hundreds of years old) – continues taking CO2 OUT OF ATMOSPHERE!

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

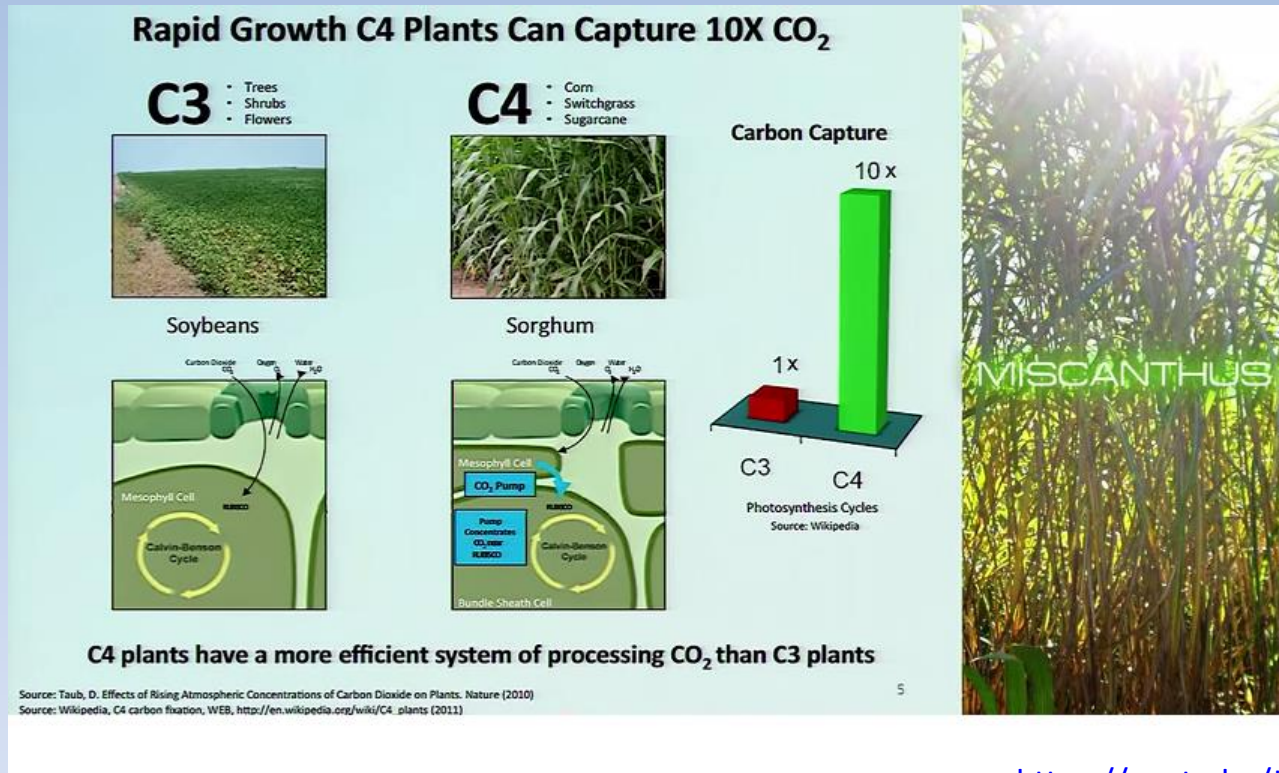
“**Biochar** is [charcoal](#) used as a [soil amendment](#). Like most charcoal, biochar is made from [biomass](#) via [pyrolysis](#). Biochar is under investigation as an approach to [carbon sequestration](#) to produce [negative carbon dioxide emissions](#).^[1] Biochar thus has the potential to help mitigate [climate change](#) via carbon sequestration.^{[2][3]} Independently, biochar can increase [soil fertility](#) of [acidic soils](#) (low pH soils), increase agricultural productivity, and provide protection against some foliar and soil-borne diseases.^[4] Furthermore, biochar reduces pressure on [forests](#).^[5] Biochar is a stable solid, rich in [carbon](#), and can endure in soil for thousands of years.^[1]”

Cool Planet - @ 9:00 minutes where this link starts

- https://youtu.be/JPIsYZLU_sM?t=535



Following slides from Cool Planet Video

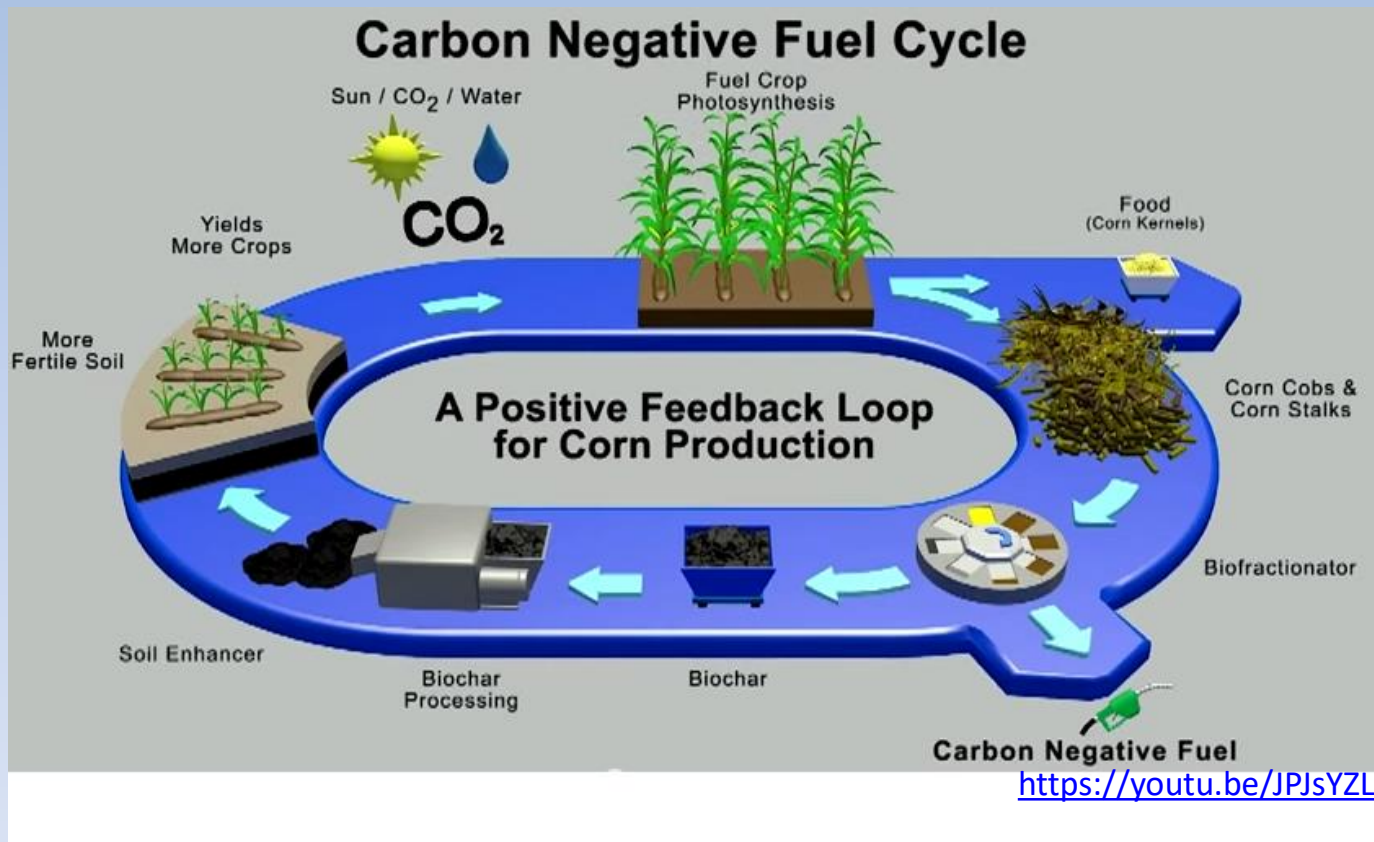


https://youtu.be/JPJsYZLU_sM?t=535

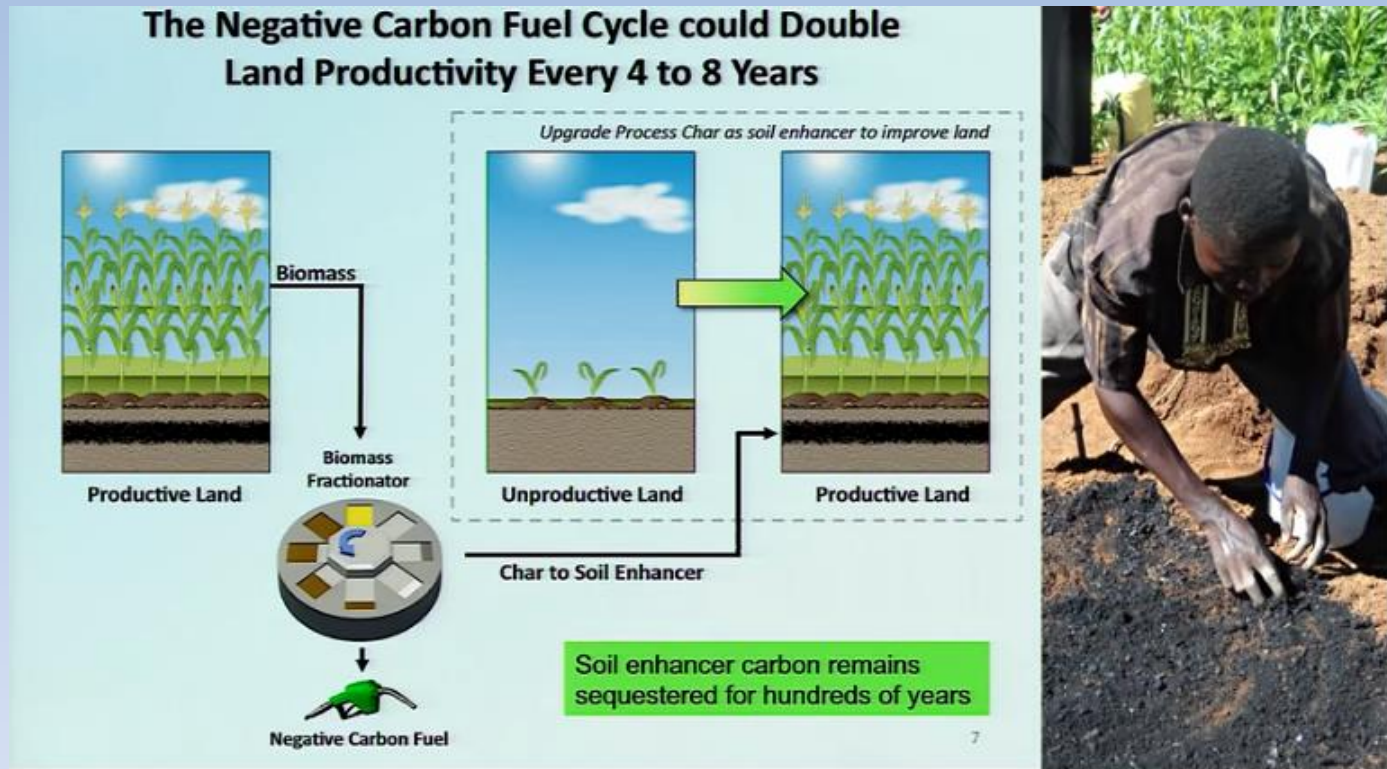
Types of Photosynthesis: links

- About C3, C4 and Cam Photosynthesis and Plants:
- Photosynthetic efficiency: http://en.wikipedia.org/wiki/Photosynthetic_efficiency
- C3 carbon fixation: http://en.wikipedia.org/wiki/C3_carbon_fixation
- C4 carbon fixation: http://en.m.wikipedia.org/wiki/C4_carbon_fixation
- Summary table comparison: <http://www.cropsreview.com/types-of-photosynthesis.html>
- C3 C4 CAM Photosynthesis video: https://www.youtube.com/watch?v=Yg_pdXzWXVA

Carbon negative fuel cycle: Biochar and Biofuels

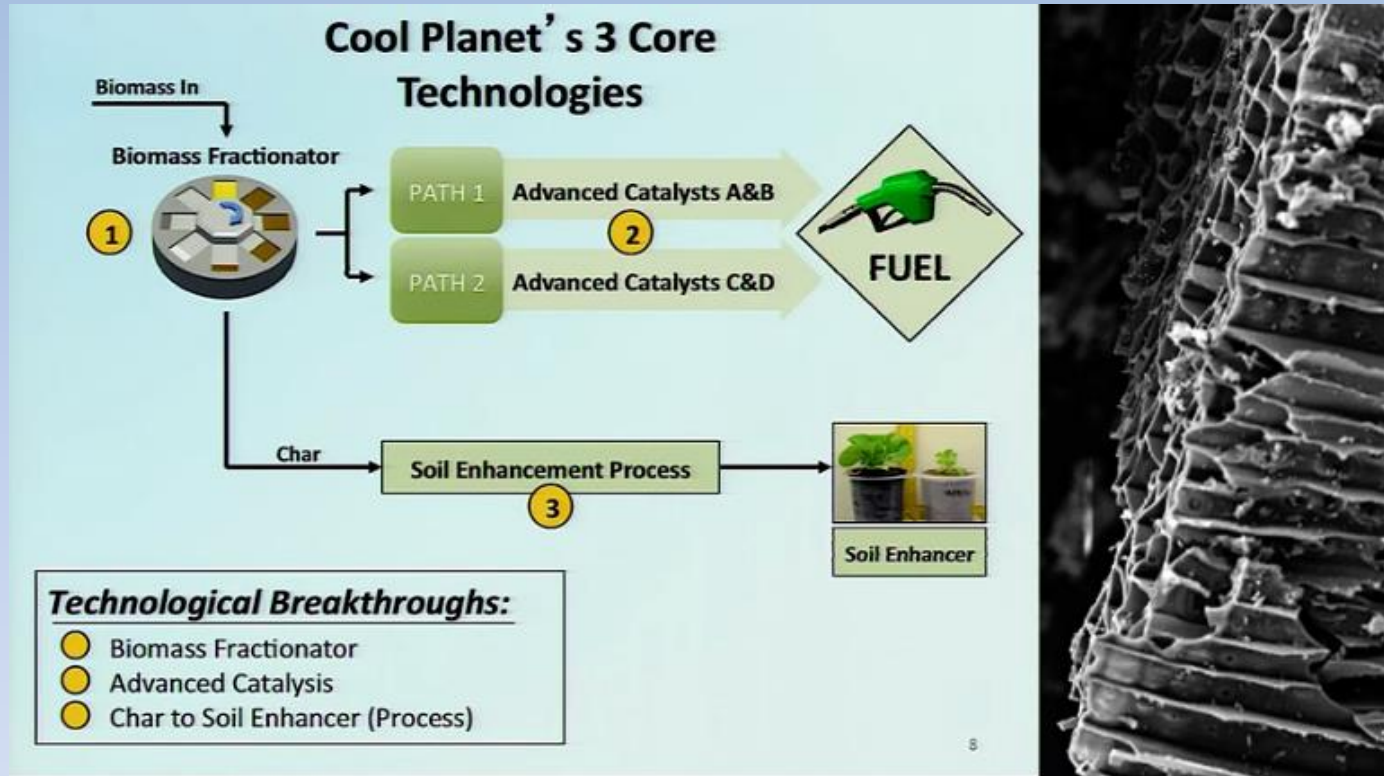


Soil Enhancement



https://youtu.be/JPJsYZLU_sM?t=535

Core Technologies:





https://youtu.be/JPJsYZLU_sM?t=535

Sponsorships



Current Plans to Deploy the Negative Carbon Fuel Cycle



Commercial Plants - 50 million gallons a year
(2,000 plants worldwide – developed world)

Global Village Plants - 1 million gallons a year
(100,000 plants worldwide – emerging world)

As suggested by:

google.org

Up to 8X gain in village income by
increasing energy & food production
while bringing the village into
the information society

9

Sponsors:

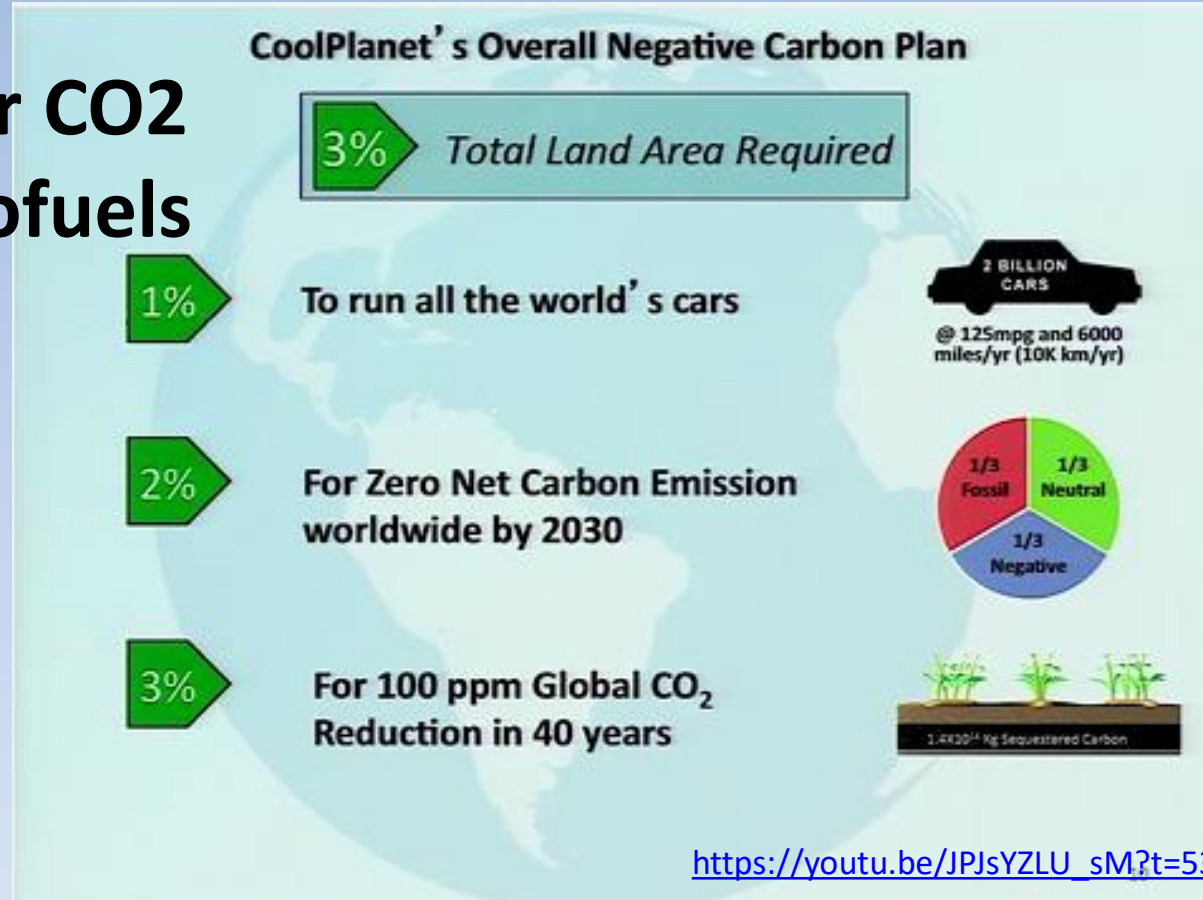
- Google ventures
- bp
- Constellation
- ConocoPhillips
- NRG
- NORTH BRIDGE venture partners
- Shea Ventures



https://youtu.be/JPJsyZLU_sM?t=535

CARBON NEGATIVE BENEFITS:

- Sequester CO₂
- create Biofuels



Bio-energy with carbon capture and storage: (BECCS)

Bio-energy with carbon capture and storage

- https://en.wikipedia.org/wiki/Bio-energy_with_carbon_capture_and_storage

Solutions: Geoengineering options



BIOCHAR

Biochar results from slowly baking biomass in the absence of oxygen. Retaining most of the feedstock's carbon, biochar can be buried for sequestration, while enriching soil.



BIOMASS

Biomass energy is a "bridge" solution for transitioning to 100 percent clean, renewable energy. Using sustainable feedstock—waste biomass or perennial crops—is crucial.

Biochar:

Slides excerpted from Ron Larson

Presentation - OLLI west, Spring 2017:

<http://denverclimatestudygroup.com/wp-content/uploads/2014/07/Larson-biochar-PART-B-BIOCHAR2017.pdf>

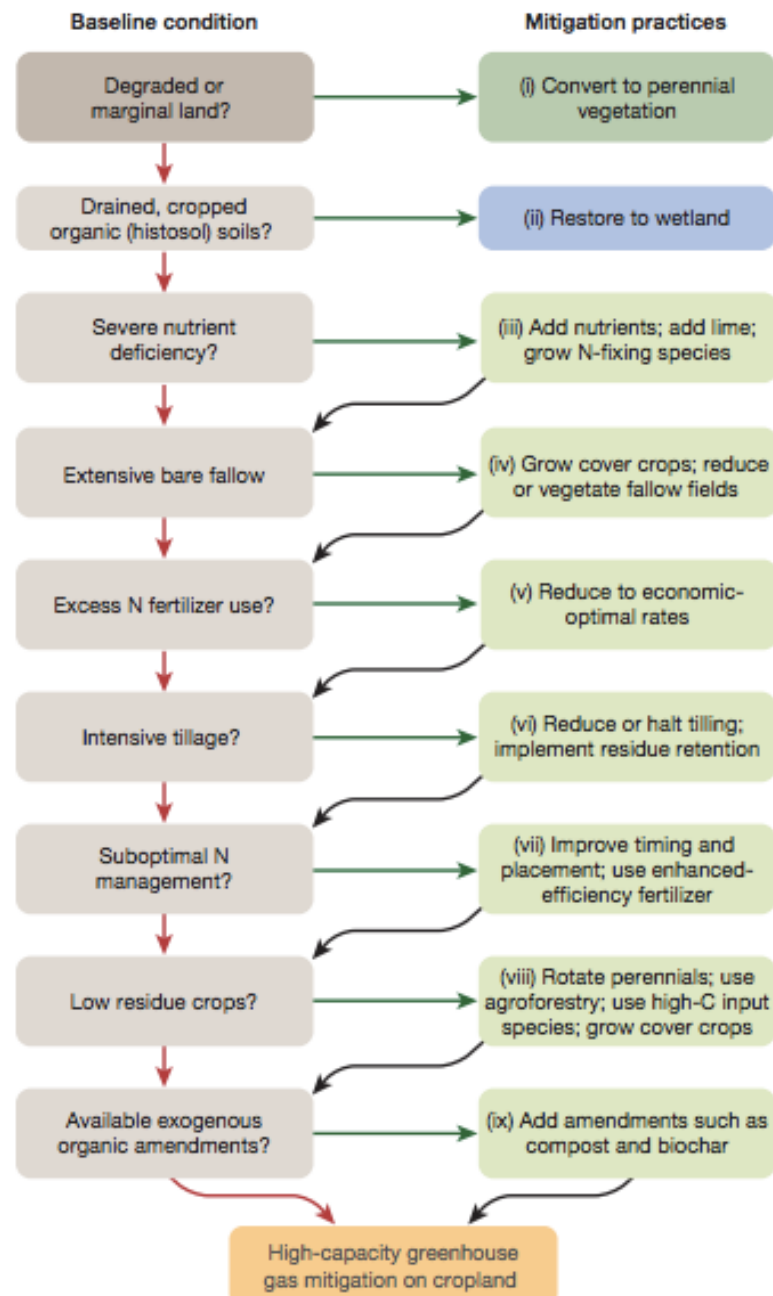
PERSPECTIVE

Climate-smart soils

Keith Paustian^{1,2}, Johannes Lehmann³, Stephen Ogle^{2,4}, David I.

Reay⁵, G. Philip Robertson⁶ & Pete Smith⁷

RESEARCH PERSPECTIVE



Next slide from

PERSPECTIVE

CLIMATE CHANGE

The trouble with negative emissions

Kevin Anderson^{1,2}, Glen Peters³

+ See all authors and affiliations

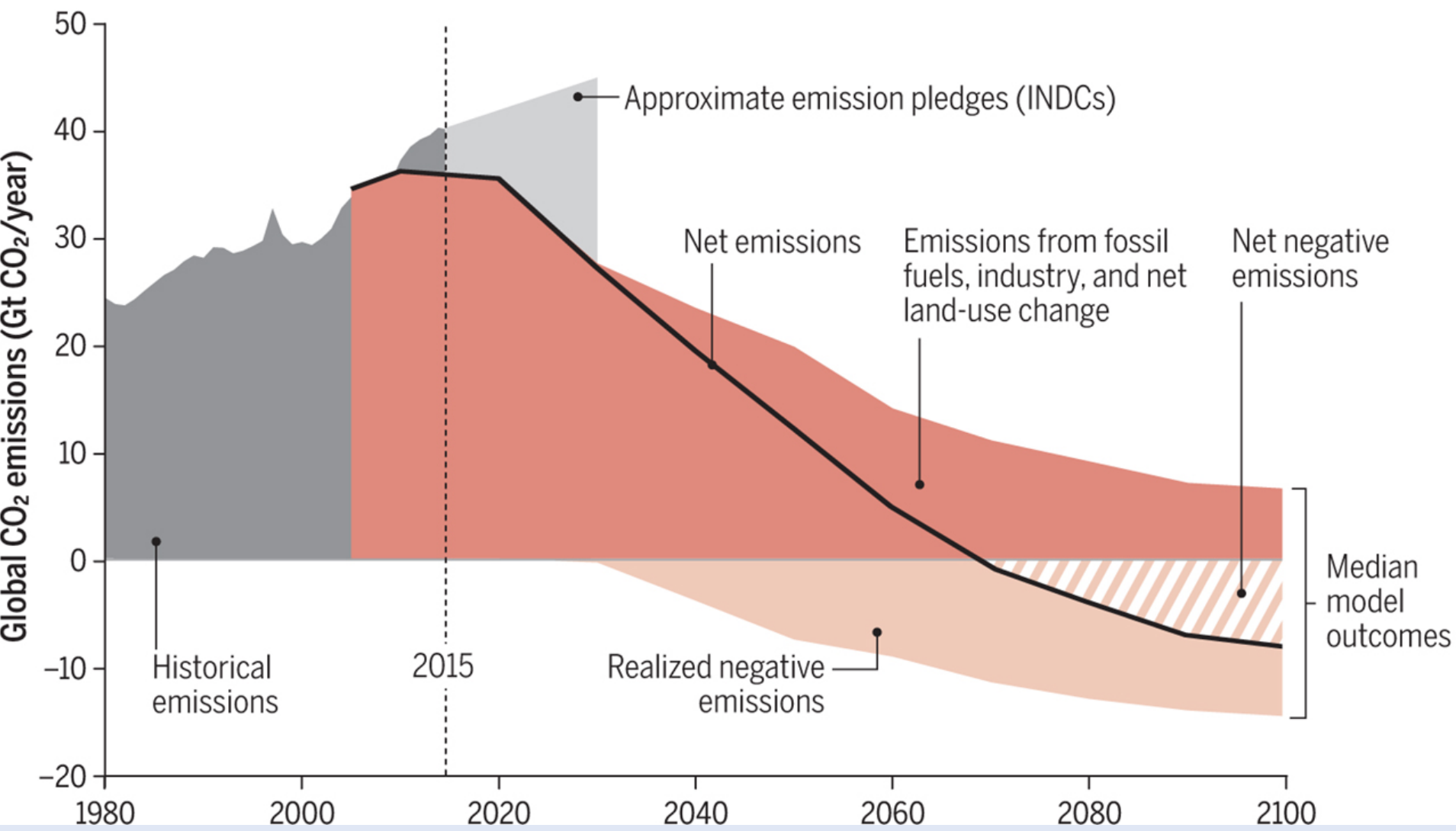
Science 14 Oct 2016:

Vol. 354, Issue 6309, pp. 182-183

DOI: 10.1126/science.aah4567

No quick fixes

Modelers generally report net carbon emissions, unintentionally hiding the scale of negative emissions. Separating out the positive CO₂ emissions from fossil fuel combustion, industry, and land-use change reveals the scale of negative CO₂ emissions in the model scenarios (16). INDCs, Intended Nationally Determined Contributions.

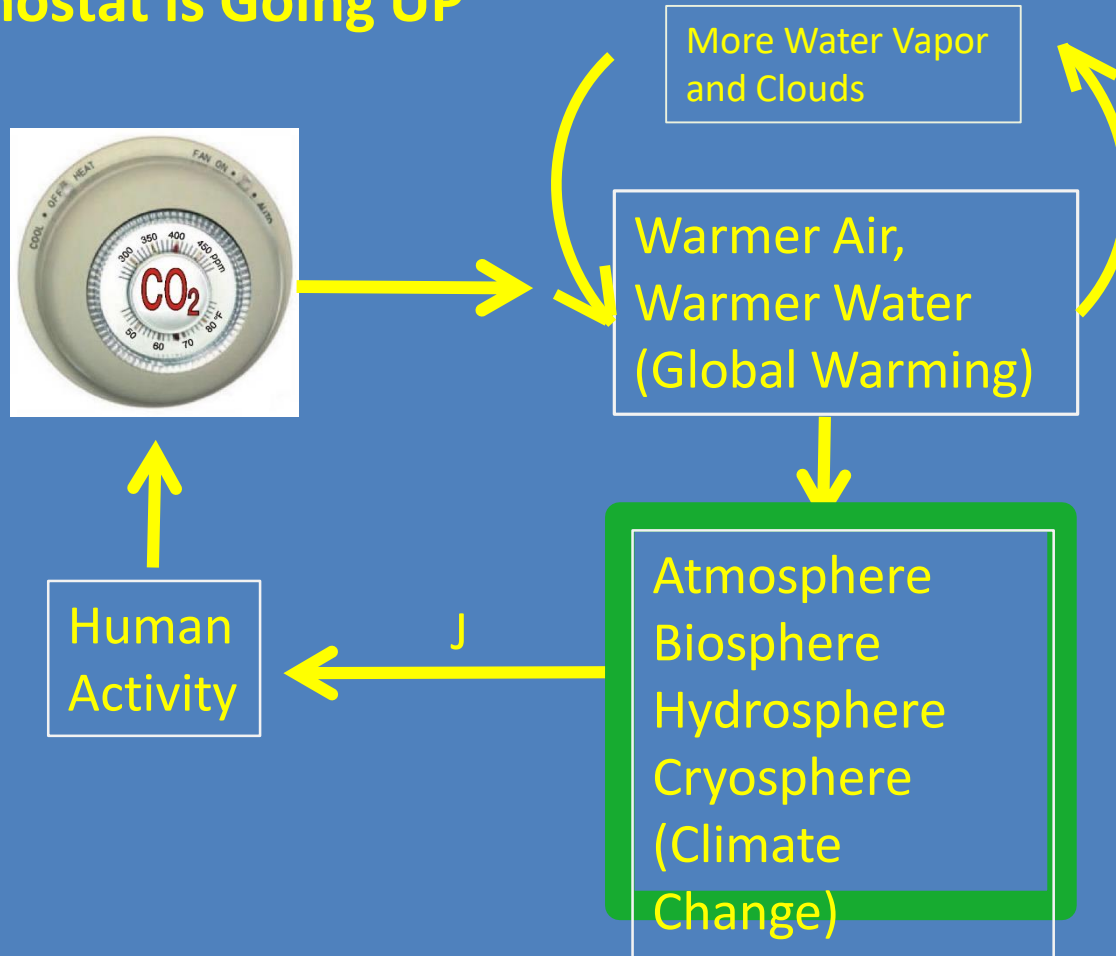


Links

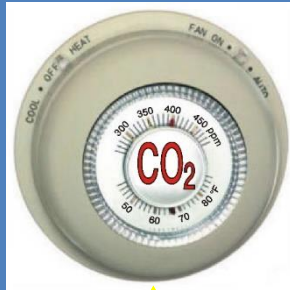
- <http://www.biocharnow.com/index.php/biochar/climate-change>
- http://nas-sites.org/dels/studies/cdr/?utm_source=Division+on+Earth+and+Life+Studies&utm_campaign=70eb2a0789-EMAIL_CAMPAIGN_2017_04_13&utm_medium=email&utm_term=0_3c0b1ad5c8-70eb2a0789-233932773&mc_cid=70eb2a0789&mc_eid=4ea23050ce
- <https://earth.stanford.edu/jason-funk>
- <https://www.google.com/search?q=center+for+carbon+removal&aq=chrome.0.0l6.5640j0j7&source=id=chrome&ie=UTF-8>

SOLUTIONS

The Thermostat is Going UP



Courtesy Phil Nelson



More Water Vapor
and Clouds

Warmer Air,
Warmer Water
(Global Warming)

Atmosphere
Biosphere
Cryosphere
(Climate
Change)

HUMAN RESPONSES

Personal
Family, Friends,
Neighbors
Town and City
State

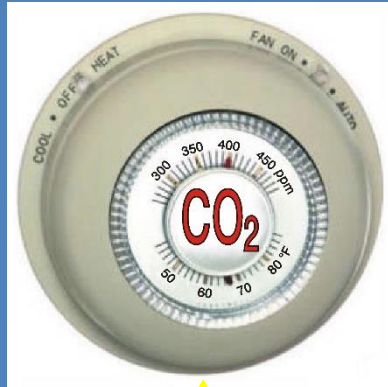
National

International

Courtesy Phil Nelson

Solutions: Local Governments

What Can Town, Cities and Communities DO?



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

Solutions: Local Governments

- <http://lakewood.org/sustainabilityplan/>
- <http://www.cityofgolden.net/live/sustainability-initiative/> and
<http://www.cityofgolden.net/government/boards-commissions/community-sustainability-advisory-board/>
- <https://www.denvergov.org/content/denvergov/en/office-of-sustainability/2020-sustainability-goals.html>
- MORE – APEN, PUEBLO, ETC.

On May 11, 2015 City Council approved Lakewood's first community-wide Sustainability Plan

Lakewood.org extracted Feb 2017

Sustainability plan: climate adaptation; energy-water-environment; sustainable economy; zero waste; public health; natural systems; transportation



Sustainability Division (2 permanent staff) in the Planning Department.

CITIES: Sustainable Denver Summit, 14 Nov 2016



Mayor Michel B. Hancock

The Sustainable Denver Summit brought together 580 leaders from across the city's business, nonprofit and civic communities to develop and announce commitments for new and expanded initiatives that will help Denver achieve its ambitious 2020 Sustainability Goals.

Solutions: Personal

- **Personal Involvement: meetings, volunteer, educate yourself and others, read**
- **Choices:**
 - **Conservation**
 - **EV (Electric Vehicles)**
 - **Solar Panels (PV – PhotoVoltaic)**

- **Volunteer:**
 - **COSEIA (CO Solar Energy Industry Assoc.)**
- **Upcoming conference:** COSEIA definitely needs help for the next few weeks. Particularly in advance of, and including, COSEIA's "Clean Energy Means Business Summit" Nov 7-8. <http://coseia.org/>
<https://www.cleanenergymeansbusiness.com/>

They should write "CEMB Volunteer" in the subject line and email to both Rebecca rcantwell@coseia.org and Keelin kkelly@coseia.org

We need folks to boost attendance by making calls, setup and breakdown, and more.



- **Personal things you can do:**
 - **Get involved**
 - **Go to meetings, volunteer**
 - **Continue educating yourself**
 - **Make some commitments regarding**
 - Conservation/reducing your Carbon Footprint
 - Get Solar – it's an investment
 - If you have 2 cars make your primary one an Electric Vehicle (EV) and have your Internal Combustion Engine (ICE) car be a hybrid
 - LOTS of economic advantages: minimal maintenance, ~115 mpg equivalent
 - If I paid Xcel for the 20,000 miles for my Leaf = ~\$500.00
 - With solar panels – house and EV 11.4% return for first year
 - Etc.

Evs (Electric Vehicles) no Emissions



Steve Stevens with Tesla X
90 kWh = 300 mile range



**Paul Belanger & Phil Nelson with
their Nissan Leafs**
30 kWh = 107 mile range

Ron Larson with Tesla S
75 kWh = 250 mile range



SOLUTIONS on a Personal Level

- **Home Solutions – LOTS OF IDEAS!**

- John Avenson – home solutions:

<http://www.avenson.net/>

- Pictures of Passive/Active
- John In Spotlight
- Links for Info
- LED Lighting
- Insulation Improvements
- Solar Shading Concepts
- SolarAccessLandScaping
- Water Conservation
- Home Automation
- FloorPlan
- FRESH AIR CERV

SO MUCH TO DO, SO LITTLE TIME FOR US! Welcome to our SERI Passive House world of Solar information and home energy improvement in Pictures. Click tabs at left for pictures and info. (Updated April 5, 2016, SEE INSULATION TAB and FRESH AIR CERV for latest PICTURES.

CONGRATULATIONS - BEST ENERGY RETROFIT:

2014 AWARD WINNER CGBG (Colorado Green Building Guild): RETROFIT CATEGORY OCT. 09, 2014



FLIR Infrared PICTURE SHOWS "before" during my "SUPER INSULATION" RETROFIT 2014-15 project, 32 degrees outside:



The two left windows and far right window are PURPLE color not passing heat out. They are Alpen Series-9 High performance.

- Steve Stevens – Beyond net zero: ethics, principles and practice -
SOLUTIONS on a Personal Level
https://www.youtube.com/watch?v=8pbL_w8bJkQ&feature=youtu.be
- CRES – NOVEMBER 30TH 7 P.M.



Beyond Net Zero (Steve Stevens - 9/23/15)

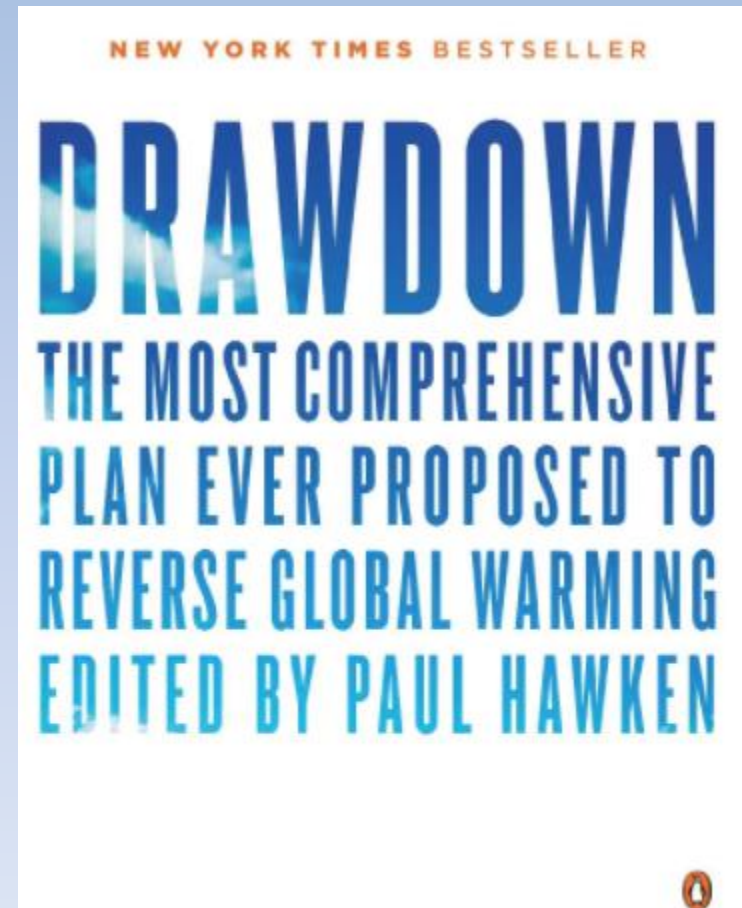
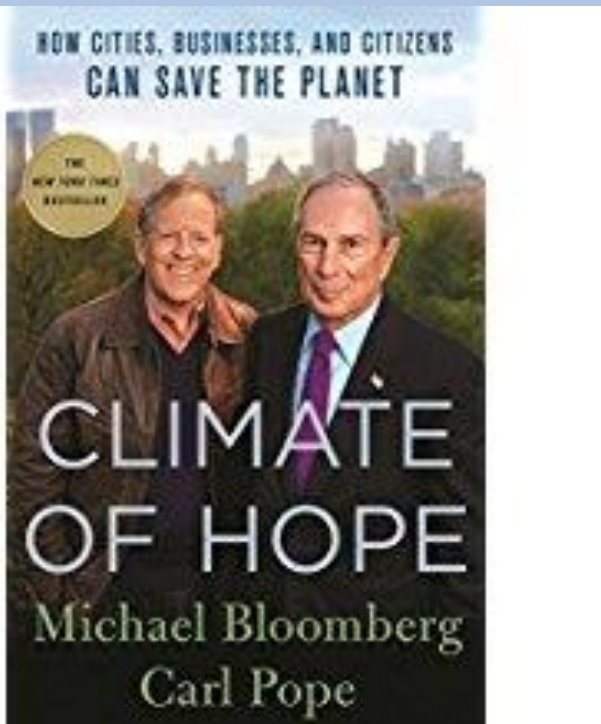
SOLUTIONS on a Personal Level

- **Organizations/websites:**
 - **350.org:** <https://350.org/>
 - **Conservation Colorado**
<https://conservationco.org/>
 - **Citizens Climate Lobby**
<https://citizensclimatelobby.org/>
 - **World Watch Institute:** <http://www.worldwatch.org/>
<http://www.worldwatch.org/bookstore/publication/earthed-rethinking-education-changing-planet-state-world-2017>
 - **Skeptical Science:** <https://skepticalscience.com/>
 - **Real Climate:** <http://www.realclimate.org/>
 - Etc.

SOLUTIONS to Address Climate Change Issues: Implies an Acknowledgement that We Need to Do Something! WHAT?

- **Newsletters:**
 - **Climate Nexus** <http://climatenexus.org/>
 - **Desmogblog**
<https://www.desmogblog.com/>
 - **Eco-Justice Ministries; Peter Sawtell –
weekly letter/”sermon”**
<http://www.eco-justice.org/> fb:
<https://www.facebook.com/EcoJusticeMinistries>
Archives: <http://www.eco-justice.org/E-list.asp>
- **Other:**

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



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

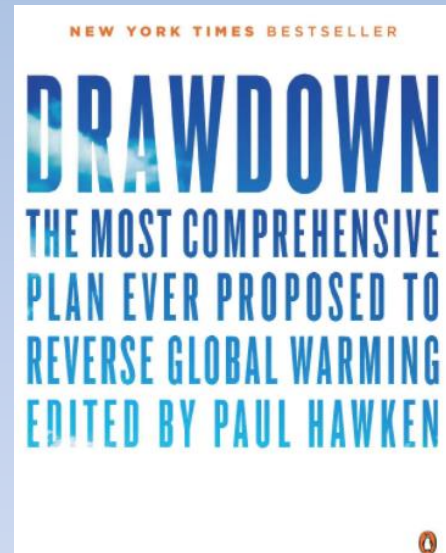
Summary of Solutions by Overall Rank

- <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

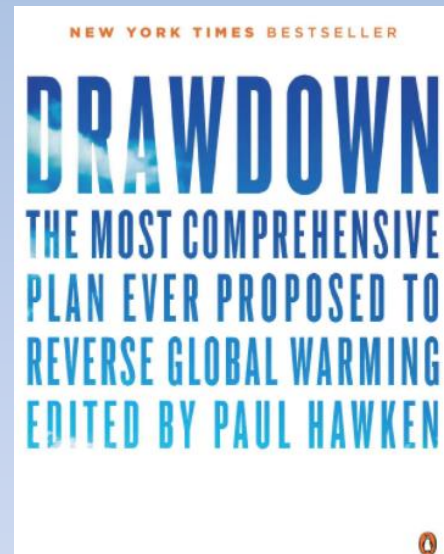
Colorado Renewable Energy Society – YouTube of selected talks:

- 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>



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



Web Links Energy/Other

- **U.S. Energy Information Administration** <https://www.eia.gov/>
- **CRES** <https://www.cres-energy.org/>
 - YouTube <https://www.youtube.com/channel/UCr81EUb2qVJVfmmIJMxEHVw>
 - NREL Presentation: GREG WILSON
<https://www.youtube.com/watch?v=7CDPHxcnq4c&t=23s>
 - Governor Ritter Presentation
<https://www.youtube.com/watch?v=agowW1QKwms&t=6s>
- <https://skepticalscience.com/How-Green-is-My-EV.html>
- <http://energysouldbe.org/>
 - Why Storage is Key for a Renewable Energy Future:
https://www.youtube.com/watch?v=Yc_hULwykvQ&t=13s
 - Clean Energy through Open Electricity Markets:
<https://www.youtube.com/watch?v=seGwTKTm38A>

OLLI West Courses to Consider

- Phil Nelson – Extreme Weather
- Alec Tsoucatos – Steady state economics – when more is not enough
- Great Decision – Peter Lohaus & Jeff Pederson
- Friday 1/26 Jim Smith, Gas cars are obsolete and here's why
- Consider OLLI SOUTH too





Tom Toles, Washington Post, 6/6/2016

In closing

**“ASK NOT WHAT YOU OUGHT TO DO, RATHER ASK
WHAT YOU MUST DO!”**

**(attributed to a philosopher – please let me know
who)**

AND

**For those that say “it can’t be done” I say: Stay out of
the way of those that are DOING IT!**

Climate of Hope

- p. 27:

**“If we don’t act now, when?
And if we don’t act, who will?”**

End of class slides October 31ST , 2017



https://i.kinja-img.com/gawker-media/image/upload/t_original/ihsllhptnnm4vb7wuvvgq.jpg

EXTRAS

Useful Links for education / passing on

- <https://www.nap.edu/catalog/12781/americas-climate-choices> 2011
- <https://www.nap.edu/catalog/12782/advancing-the-science-of-climate-change> 2010
- <https://www.nap.edu/catalog/11175/radiative-forcing-of-climate-change-expanding-the-concept-and-addressing> 2005
-

other

- CCL:
- Link for [CCL Power Point Presentations FEB 25, 2017](#)
-
- Link to [The Transition to Renewable Energy and the Colorado Economy](#)
- <https://drive.google.com/file/d/0B9EqUuZ68yOLTEpKU Ud3Zld4Vzg/view>
-
- <https://drive.google.com/drive/folders/0B9EqUuZ68yOLbWg3aXNheEZhWDQ>

So a little more on Citizens Climate Lobby

Guiding Principles

- Politicians don't create political will, they respond to it.
- The bipartisan carbon fee and dividend policy is a simple, transparent policy to address the climate crisis.
- CCL volunteers show respect for diverse views and appreciation for the work of others.

SOLUTIONS

Carbon fee/dividend:

- citizensclimatelobby.org/ccl-applauds-republican-resolution-calling-for-action-on-climate-change/
- <http://citizensclimatelobby.org/>
- Facebook:
 - CCI – national:
<https://www.facebook.com/CitizensClimateLobby/?ref=ts>
 - CCL-Colorado:
<https://www.facebook.com/CitizensClimateLobbyDenverChapter/>

Ways to reduce your carbon footprint

- Ways to save <http://yourenergy.extension.colostate.edu/>
-
- Other <https://youtu.be/BxKfpt70rLI>
-
- <https://thinkprogress.org/its-been-45-above-normal-in-oklahoma-this-february-ba30f7bde27a>
- EDF [**Check out these tips from an EDF climate scientist on actions you can take in your own home and community to stop climate change.**](#)

- <http://www.avenson.net/>
- <https://350.org/>
-
- <http://www.yaleclimateconnections.org/2017/04/changing-minds-on-a-changing-climate/>
- <https://www.theatlantic.com/science/archive/2017/04/climate-polling-burnout/523881/>
- steve stevens – Beyond net zero:
- ethics,
- principles and
- **34:16 - practice -**
https://www.youtube.com/watch?v=8pbL_w8bJkQ&feature=youtu.be

SOLUTION

- VOTE
- SUPPORT YOUR SENATORS AND REPRESENTATIVES SPEAKING OUT
- WRITE/HARRASS THOSE THAT ARE NOT

Senator Bennet

- <https://www.bennet.senate.gov/?p=blog&id=3860>
 - **Bennet Urges President to Rescind Anti-Climate Executive Order:**
<https://www.bennet.senate.gov/?p=blog&id=3860>

Rep. Ed Perlmutter

- <http://perlmutter.house.gov/>
- **Perlmutter Responds to Trump's Climate Change Executive Order:**
<http://perlmutter.house.gov/news/documentsingle.aspx?DocumentID=1671>

Support our Youth

March 24, 2017

Common Dreams | Colorado Youth Score Decisive Legal Victory
Against Fracking



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

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

IN SUMMARY

1. The world has been getting better
2. **Changes** are happening; **WE NEED TO CHANGE:**
 - 25+ Ways to Reduce Your Carbon Footprint:
<http://cotap.org/reduce-carbon-footprint/>
3. We need to support science and new technologies

25 charts and maps that show the world is getting much, much better

- <http://www.vox.com/2014/11/24/7272929/charts-thankful>

So – let's not regress; let's continue to improve our world and transition to a new future: A NEW NORMAL

There are few, if any, historical examples of civilizations consciously making sacrifices on behalf of descendants two or more generations removed.

- In that regard **we need a social paradigm shift**
- Gloom and Doom? NO! IT'S A CHALLENGE, and humanity has always been challenged and we are an adaptable species that has met the challenge over and over again!

1. ECONOMIC PROGRESS: Extreme poverty has fallen
2. Hunger is falling
3. Child labor in decline
4. More leisure time
5. Income spent on food has plummeted in US
6. Health care: life expectancy is rising
7. Child Mortality is down
8. Death in childbirth is rarer
9. People are getting taller
10. More people have access to malaria bednets

<http://www.vox.com/2014/11/24/7272929/charts-thankful>

11. Guinea worm is almost eradicated

12. Teen births in US are down

13. As is smoking

14. War is on the decline

15. Homicide rates are down in Europe

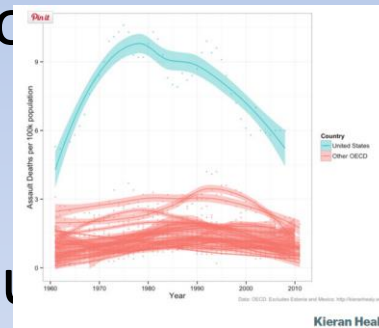
16. And the US too

17. Violent crime declining

18. Rapidly reduced the supply of nuclear weapons

19. More countries are democracies

20. More people going to school longer



<http://www.vox.com/2014/11/24/7272929/charts-thankful>

21.Literacy is up as well

22.US unsheltered homeless declined nearly
32% since 2007

23.Moore's law is still going (# transistors on a
chip doubling) i.e. greater computer power

24.Access to internet increasing

25.Solar power is getting cheaper

Web Links Energy/Other

- **U.S. Energy Information Administration** <https://www.eia.gov/>
- **CRES** <https://www.cres-energy.org/>
 - YouTube
<https://www.youtube.com/channel/UCr81EUb2qVJVfmmlJIMxEHVw>
 - NREL Presentation: GREG WILSON
<https://www.youtube.com/watch?v=7CDPHxcnq4c&t=23s>
 - Governor Ritter Presentation
<https://www.youtube.com/watch?v=agowW1QKwms&t=6s>
- <https://skepticalscience.com/How-Green-is-My-EV.html>
- <http://energyshouldbe.org/>
 - Why Storage is Key for a Renewable Energy Future:
https://www.youtube.com/watch?v=Yc_hULwykvQ&t=13s
 - Clean Energy through Open Electricity Markets:
<https://www.youtube.com/watch?v=seGwTKTm38A>