

Climate Change Solutions

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Outline of Presentation

- Introduction
- Some potential solutions
 - Benefits to the climate
 - Ancillary benefits
- Barriers to implementation
- Crisis is opportunity

Time to Shift from Climate Assessment to Remediation

- 2014 National Climate Assessment:
 - “Climate change is already affecting the American people in far-reaching ways.”
- Hoesung Lee, leader of the United Nations Intergovernmental Panel on Climate Change:
 - It’s time to shift focus from tracking climate change impacts to finding solutions
 - The world must:
 - Achieve global peaking in a very short time
 - Reduce greenhouse gas (GHG) emissions at least 3% a year so that by 2100 we will achieve zero emissions

<http://nca2014.globalchange.gov/>

<http://www.theguardian.com/environment/2015/oct/12/new-ipcc-chief-calls-for-fresh-focus-on-climate-solutions-not-problems>

Broad Global Support for Limiting GHG Emissions

- Pew Research Center - polled 40 countries
- Reported results November 5, 2015 – global medians:
 - 78% support their country limiting GHG emissions as part of international agreement in Paris in December 2015
 - 54% say climate change is a very serious problem
 - 51% say climate change is harming people now
 - 40% are very concerned that climate change will hurt me personally
- Primary concern: drought and water shortages
- In the U.S., 66% believe people will need to make significant lifestyle changes

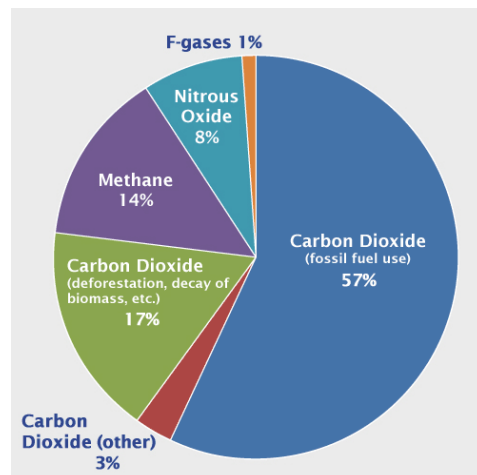
<http://www.pewglobal.org/2015/11/05/global-concern-about-climate-change-broad-support-for-limiting-emissions/>

Governments Aren't Doing Enough

- United Nations Study - October 30, 2015
 - Assessed plans to limit GHGs submitted by 146 countries
 - Pledges are not enough to meet target of no more than 2 degrees Centigrade increase in global warming by the end of this century
 - Would deliver 3 degrees C increase
 - Better than current trends, which if unchecked would lead to 5 degrees C increase

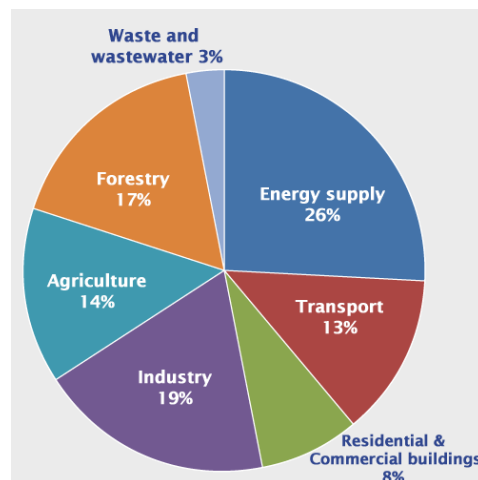
<http://www.theguardian.com/environment/2015/oct/30/worlds-climate-pledges-likely-to-lead-to-less-than-3c-of-warming-un>

Types of Greenhouse Gases (GHGs)



<http://www.epa.gov/climatechange/ghgemissions/global.html>

Sources of GHGs



<http://www.epa.gov/climatechange/ghgemissions/global.html>

Climate Change Solutions

- Two major types:
 - Coping with impacts of previously emitted GHGs
 - Reducing new GHG emissions
- Both types of solutions are needed - now
- This presentation focuses on examples that:
 - Aren't technically difficult
 - Don't require sacrifices from citizens
 - Could significantly reduce GHG emissions

0 - No Action Alternative

- What is climate change costing us now?
 - Lives - by heat waves, wildfires, water problems, insect-borne disease, crop damage
 - Dislocation of populations
 - Money - examples:
 - Drought in western U.S. – >300 square miles of crop land not planted this year in CA's Central Valley
 - Damage from severe events: in 2012 Hurricane Sandy cost the U.S. \$65B and drought cost the U.S. \$35B
 - How we feel:
 - Fear of uncertain/worse future
 - Guilt that we are making a mess and should do more to stop
 - Eroded confidence in our society, feeling we lack control
- Costs will grow as problem becomes more severe

1 – Phase Out Subsidies for Combustion-Based Energy

- Would affect all source categories of GHGs
- What are subsidies?
 - Government takes money from us in the form of taxes
 - Government gives this money to industries to help them
 - We pay the retail price of something (e.g., a gallon of gas)
 - **Plus** we pay the hidden subsidies as part of our taxes
 - Alternatives receiving fewer subsidies are at a disadvantage – they have to charge us a higher price
 - Customers choose the subsidized alternative
 - Competition is stifled
 - Investors are turned off by apparently high prices of alternatives

1 – Climate Benefits

- International Monetary Fund - 188 countries
 - Report estimates worldwide energy subsidies for petroleum, coal, natural gas, and electricity for 2015: **\$5.3 trillion** (\$5,300,000,000,000). This is equal to:
 - 6.5% of global gross domestic product (GDP = economic activity)
 - More than all the world's governments combined health spending
 - Consists of 20% payments and 80% externalities
 - 75% of the externalities are local environmental damages
 - Only 25% of the externalities are global warming effects
 - Subsidy reform helps the climate because:
 - People use less energy if they know what they really pay
 - Clean and green alternatives can compete
 - IMF estimates eliminating these subsidies would reduce global CO₂ emissions by **17%**

<https://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf>

1 – Other Benefits

- Citizens fare better - from competition on a level playing field
- Potential for increased economic growth
 - Consumers have more money to spend on other things
 - Government can use the former subsidy money on beneficial things
- Increased energy security – we'll never run out of solar energy
- Cleaner environment
 - Less emission of conventional air pollutants
 - Less oil spills to land and water
 - Less damage from coal mining - e.g., mountaintop removal
- Better health
 - Could reduce premature deaths from local air pollution by >50%
 - Health problems caused by air pollution cost **4%** of GDP in the 15 largest CO₂-emitting countries
 - Safer jobs - e.g., coal mining has high rates of death, injury, and illness

2 – Phase Out Subsidies for Agriculture

- U.S. ag subsidies during 1995-2012:
 - \$292 billion
- Most goes to big industrial ag
 - **10% of farms** collected **75%** of all subsidies
 - **62%** of farms in United States did not collect subsidy payments
- Few subsidies for fruits, vegetables, organic
- Removing ag subsidies would level the playing field
 - Fruits, veg, organic would be more competitive

2 – Agricultural Subsidies (cont'd)

Largest expenditures in order of total dollars – U.S. ag subsidies during 1995-2012:

1	Corn Subsidies	11	Livestock Subsidies
2	Wheat Subsidies	12	Peanut Subsidies
3	Cotton Subsidies	13	Barley Subsidies
4	Conservation Reserve Program	14	Tobacco Subsidies
5	Soybean Subsidies	15	Sunflower Subsidies
6	Disaster Payments	16	Wetlands Reserve Program
7	Rice Subsidies	17	Canola Subsidies
8	Sorghum Subsidies	18	Oat Subsidies
9	Dairy Program Subsidies	19	Apple Subsidies
10	Env. Quality Incentive Program	20	Sugar Beet Subsidies

2 – Climate Benefits

- Industrial ag – high GHG emissions
 - Producing/applying energy-intensive fertilizers and pesticides
 - Irrigation practices
 - Tilling practices
 - Livestock management practices
 - Soil erosion
- Organic ag – CO₂ emissions are **48% to 66% lower**
 - Maintains and increases soil fertility
 - Fewer high energy inputs
- U.N.: agriculture could become **carbon-neutral** in 20 years by worldwide switch to organic
 - Would reduce global GHG emissions by **14%** (EPA pie chart)
- Studies show organic can feed the world
- Organic farmer Joel Salatin: “We don’t want subsidies for anybody, including ourselves.”

2 – Other Benefits

Removing ag subsidies has additional benefits:

- Improved human health:
 - Diet includes more fruits and veg
 - Less toxic exposure (e.g., pesticides) – consumers, workers
 - More nutritious food (e.g., more trace minerals)
- Healthier wildlife (e.g., pollinators not killed by pesticides)
- Healthier soil, more water retention, less soil erosion
- Cleaner water, air, soil
- Lower health care costs
- Stronger local economies – smaller farms more able to compete

3 – Stop Deforestation

- Trees remove CO₂ and store it in wood and soil
 - U.S. forests remove **12%** of all U.S. GHG emissions
 - Logging is a “double whammy”
 - Releases CO₂
 - Destroys future CO₂ capture capacity
 - Nearly every country subsidizes its timber industry
 - Many countries subsidize biomass power plants
 - Devastating climate, environmental, human impacts
- Must preserve and restore forests, use wood wisely
 - Both temperate and rain forests
 - Brazil has reduced deforestation in the Amazon by 82 percent
 - Deforestation in U.S. quietly continues

<http://www.whitehouse.gov/sites/default/files/image/president27climateactionplan.pdf>

<http://www.reuters.com/article/2015/09/30/us-development-goals-forests-idUSKCN0RU0NF20150930>

3 - Biomass Power Plant - Burlington VT



3 - Deforestation



Windsor Jamb State Park, MA - 2008



3 - Forests Storing Carbon

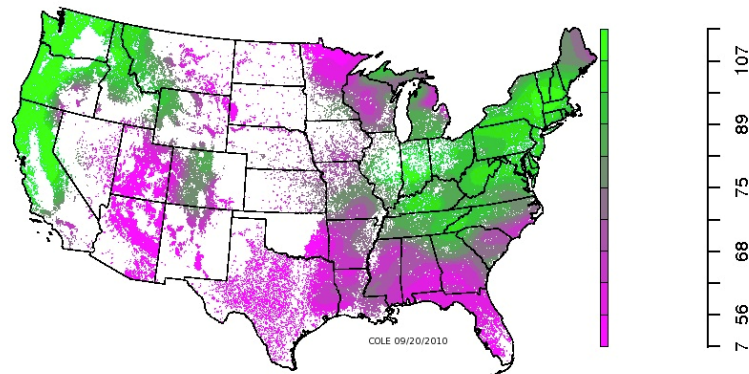
Quabbin Reservation, MA



3 - Forest Carbon Storage

<http://www.ncasi2.org/COLE/>

COLE Map
Total Aboveground Carbon (metric tons/hectare)



3 - Benefits

- Climate:
 - Reduce GHG emissions from deforestation – some **portion of the 17%** of global GHG (EPA)
 - Increase removal of CO₂ from atmosphere - **?%**
- Other:
 - Cleaner air and water
 - Less soil erosion
 - Wildlife habitat
 - Flood storage and water cycle moderation
 - Shade and temperature moderation
 - Nature and wilderness for humans
 - Inherent value of plants and animals unrelated to human benefits

4 – Provide Access to Modern Contraception

- World population growth in 2012:
80 million
- Worldwide unintended pregnancies in 2012:
80 million
- Population would stabilize if women had the ability to prevent pregnancies they don't want

<http://www.newsweek.com/2014/12/26/fixing-crowded-earth-293024.html>

4 – Benefits of Access to Contraception

- Climate: **8% to 15%** reduction in global carbon emissions
- Other:
 - Improved health and quality of life
 - Economic growth (women can do more paid work)
 - Reduced habitat destruction
 - Reduced species extinctions
 - Reduced pollution
 - Saves money: \$1 spent on family planning saves \$6 on health care, immunization, education, and other services

5 – Energy Efficiency

- Wasting less energy through transmission, heat loss, and inefficient technology
- U.S. Dept. of Energy: “Energy efficiency is one of the easiest and most cost-effective ways to combat climate change.”
- Efficiency is the cheapest electricity resource:
 - ~1/3 the cost of new electricity generation (MA DOER, 2005)
- Example opportunities for improving efficiency:
 - Improve the electric grid
 - Reduce “dracula load” = the electricity devices use when off
 - Stop flow of electricity when devices done charging
 - Outdoor lights turn themselves off during daylight hours
 - More efficient transportation, buildings, appliances, equipment
 - Conserve water: e.g., water heating = 9% of residential electric use

5 – Benefits of Energy Efficiency

- Big opportunity in North America
 - North Americans use twice as much energy as Europeans
- Climate benefits: reduced GHG emissions
- Other benefits:
 - Cleaner air
 - Improved competitiveness of businesses
 - Reduced energy costs

6 – Individual Actions

- Reduce senseless waste and save money
 - Turn lights and devices turn off when not in use
 - Use power strips to reduce “Dracula load”
 - Drive less, in well-maintained efficient vehicles not hauling around a lot of unnecessary stuff
 - Reduce food waste – 40% of all food in the U.S. is thrown away
 - Print and copy judiciously
 - Get off unwanted mailing lists
 - Conserve water
 - Recycle and reuse more

<http://www.imeche.org/knowledge/themes/environment/global-food>

<http://www.scientificamerican.com/article/10-solutions-for-climate-change/>

6 – Individual Actions

- Choose greener products – may pay more now and less later
 - Light-emitting diode (LED) light bulbs
 - Organic food, and less meat (esp. beef)
 - Energy-efficient vehicles, appliances, devices
 - Less single-use, unnecessary, and cheap products that won't last
 - Buy less packaging
 - Clean energy, e.g., rooftop solar

6 - House of My Neighbor in Her 80s



- Solar hot water
- Solar electric – supplies 2/3 of electricity needs of the house
 - Including recharging her electric car

6 – Individual Actions

- Conserve energy
 - Plug air leaks in home
 - Programmable thermostats
 - Outdoor lights turn off when it's light out
 - Low water flow devices, e.g., showerheads
 - Run full dishwasher loads, air dry
 - Run full clothes washer loads, cold water, air dry
 - Walk, bike, ride more
 - Telecommute more, live closer to work/school

6 – Individual Actions

- Outreach
 - Be an example
 - Let your politicians know your thoughts
 - Support non-profits – sign petitions, donate, participate
 - Educate
 - Defend clean energy, forests, sustainability
 - Push for sustainability at work/school/home

Barriers to Implementation

- Laziness, inertia, apathy
- Uncertainty about how to solve the problem
- Gradual nature – no siren goes off saying “act now” - not like a bomb drop
- Scope and consequences are hard to comprehend
 - Global problem
 - Hard to imagine 4', 10', or more of sea level rise
- Time lag between implementing solutions and seeing results
- Global gridlock:
 - Many countries refuse to act until others act
 - U.S. commitment has been weak
 - Despite U.S. having emitted more cumulative GHGs than any other country

Barriers - continued

- Variable nature of climate and weather
- Many simply hope scientists are wrong
- Many hope we can wait to act
- Limiting beliefs – e.g.,
 - “Our society is incapable of fixing the problem”
 - “Citizens can’t make industry and government change their ways”
- Confusion created by vocal climate deniers:
 - Head of U.S. Senate Environment and Public Works Committee declared climate change to be “the greatest hoax played on mankind”

Barriers - continued

- Lobbying by special interests:
 - Influences government
 - Citizens become disillusioned with the government
 - Political economist Robert Reich: *“Many people have become deeply cynical about politics.... If we give up on politics, we give up on our democracy. And if we give up on democracy, we don’t stand a chance. That’s what the moneyed interests want.... Then they run everything, and they get everything.”*
- Disagreement over solutions
 - Fear that helping the climate will hurt the economy
 - Some prefer unproven quick-fix technologies later to acting now – e.g., blasting particles into the atmosphere to cool the planet
- Citizens are frazzled

Hopeful Signs

- 97% of scientists: humans are causing climate change
- Most Americans citizens support government action
- 11/2014 agreement between President Obama and Chinese President Xi Jinping
- Millions worldwide participated in the massive Peoples Climate March 9/2014
 - Thousands of rallies in 162 countries
- Young people in the U.S. are suing states and the federal government for not protecting the climate
- President Obama's Clean Power Plan
- Many individuals, companies, and governments are reducing GHG emissions on their own

Example Cities Pledging to Achieve 100% Clean Energy within 35 Years

U.S.

- Aspen, Colorado
- San Diego, California
- San Jose, California
- San Francisco, California

International

- Copenhagen, Denmark
- Bonaire, The Caribbean
- Munich, Germany
- Isle of Wight, England
- Frankfurt, Germany

<http://www.mnn.com/earth-matters/energy/stories/10-cities-aiming-for-100-percent-clean-energy>

Hopeful Signs – Within the Past Week

- President Obama rejected the Keystone XL Pipeline
 - Would have brought tar sands oil from Canada to Texas
- Senators announced Keep It In the Ground Act of 2015
 - End new federal fossil fuel leasing on public lands and oceans
 - Cancel existing offshore federal oil/gas leases in the Arctic
 - Keep up to 450 billion tons of carbon pollution from entering the atmosphere
- Important U.N. Climate Change Conference in Paris next month

Could Addressing Climate Change Create an Economic Boom?

- U.S. Senator Gaylord Nelson:
“The economy is a wholly owned subsidiary of the environment.”
- Former Mexican President Felipe Calderón:
“Reducing greenhouse gas emissions requires action in the very same areas that throughout history have driven economic growth: investment in efficiency, infrastructure, and innovation.”

Could Addressing Climate Change Create an Economic Boom?

- Crisis is opportunity:
 - The Great Depression, then World War II, then economic boom, then throw-away society
 - After the Great Recession, could war on GHGs create an economic boom and a green society?

Next Steps

- Question assumptions:
 - Is addressing climate change really so hard?
 - Is addressing climate change really harder than what we're doing now?
 - Do we really have to sacrifice to fix the climate?
 - Are lifestyle changes unpleasant?
 - Will clean living cost more?
- Do individual actions that make sense and are fun

Links and Contact Info

- Presentation is based on two of 2015 *Huffington Post* articles on climate change, which include links to references not cited in the slides:
 - http://www.huffingtonpost.com/ellen-moyer-phd/costeffective-solutions-t_b_6414052.html
 - http://www.huffingtonpost.com/ellen-moyer-phd/its-time-to-fix-the-climate-why-do-we-delay_b_6603254.html
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