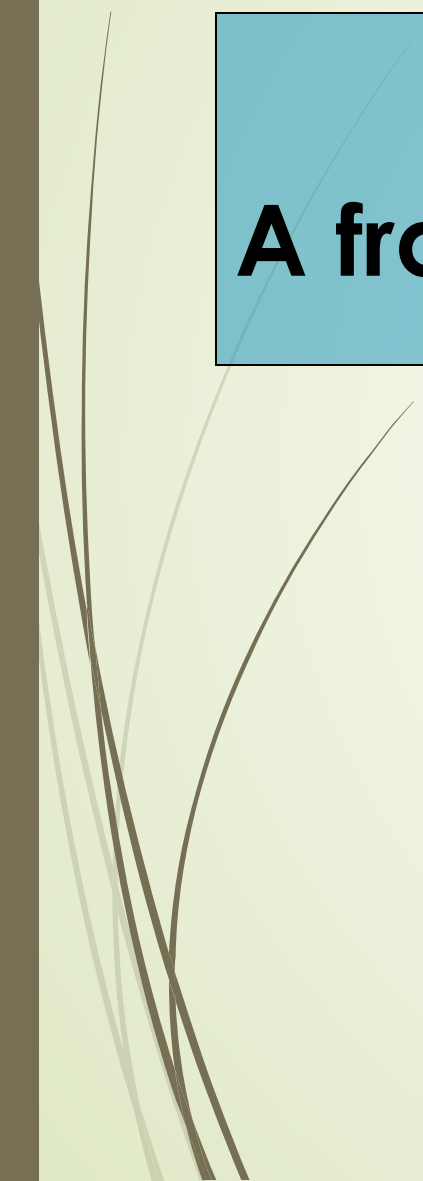




Fossil Fuels and Health: A frame that expands the picture

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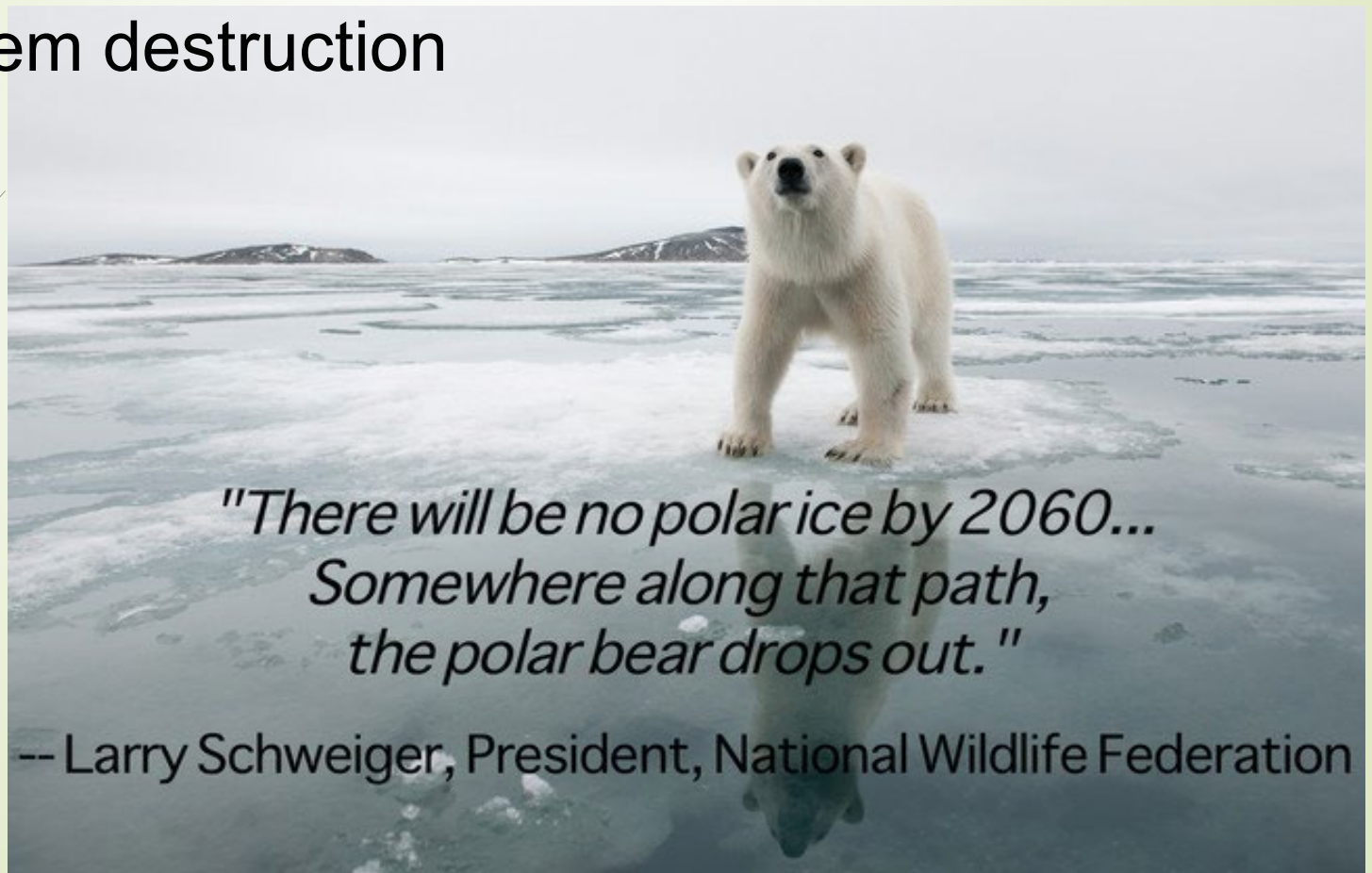
Outline

1. Issue Framing: How do we talk about the health costs of fossil fuel use?
2. What does Public Health have to say?
What is the evidence?
How is it connected?
3. What should we do with this this evidence?
4. Discussion and Questions

How do we typically talk about the problems with fossil fuel burning?

What is the first topic that usually comes up?

Ecosystem destruction



*"There will be no polar ice by 2060...
Somewhere along that path,
the polar bear drops out."*

-- Larry Schweiger, President, National Wildlife Federation

These discussions are very important . . .

but are they persuasive to everybody?

Maybe not

Some people do not seem concerned about these effects (even though they should be)

These effects can seem

far away

and mostly in the future

So if some people don't care about arctic animals in 2060 . . .

what do they care about?



What if the use of fossil fuels had already harmed and was actively continuing to harm

Your family

Your friends

Your community

Your country



... and everyone else on the planet

It is

and the public health literature can tell this story

If people understand how unsustainable energy sources are already hurting their loved ones . . .

they can better perceive the problem and start talking with others about solutions

Others?

Governments (local and national)

Hospitals


Health Systems and Payers

Corporations

Organized Religions

Trade Associations


Educational Institutions etc.



**To a large extent you
(the students and faculty here today)**

**already have a broad understanding of the
health effects of fossil fuels that are
mediated by climate change**

**and you know that fossil fuels are not the
only driver of climate change**



**but we also cannot forget that climate
change is not the only effect of fossil fuels**

Discussion Frames: A Ven Diagram of Health Effects

Climate Change
Effects

Fossil Fuel
Mediated Climate
Change Effects

Fossil Fuel
Effects



If we exclusively use the frame of climate change effects beyond climate are discussed as “latent co-benefits of mitigation” rather than ongoing documented harms

Is the term “co-benefits” . . .

helpful?
misleading?


Is removing harm a “bonus”?

or is it remediation and justice?

In other words,

The documented human suffering, inequity, and disease that flows from the use of fossil fuels is

insufficiently described when it is labeled as a “co-benefit” of climate change mitigation




Rather than an afterthought, these are the first and well documented (if poorly appreciated) harms of fossil fuels

Just to be clear:

We need the frame of climate change.

**It is necessary.
Is it sufficient?**

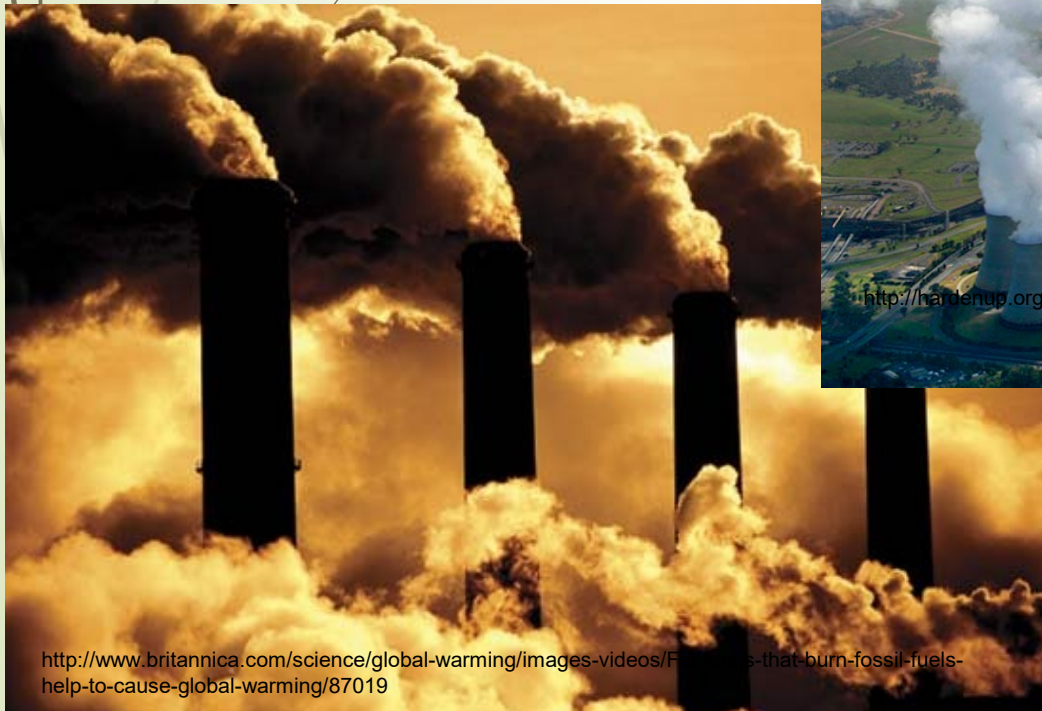
An additional frame to consider:



**The public health impact of
fossil fuels**

What is this doing to us?

What is this doing to our loved ones?



<http://hardcup.org/climate-change/causes-of-climate-change/burning-fossil-fuels.aspx>

www.airviewonline.com.au

<http://www.britannica.com/science/global-warming/images-videos/Fossil-fuels-that-burn-fossil-fuels-help-to-cause-global-warming/87019>

The Public Health Impact of Fossil Fuel Burning

Let's start with Climate Change Related Health Effects

- more frequent severe weather events (these come with injuries, illnesses, and deaths)
- changing CO₂ levels and temperatures may increase allergens and asthma symptoms
- Decreased quality or quantity of water supplies in some areas and increased probability of civil conflict
- heat related disease and deaths increase
- disease carrying insects further expand their geographic ranges (i.e. Malaria can go wherever the Anopheles mosquito goes)

<http://www.cdc.gov/climateandhealth/effects/>

The Public Health Impact of Fossil Fuel Burning

Ok . . .

these are the common problems that are discussed when public health people discuss climate change

These problems are huge and serious but . . .


Acting requires changes



so maybe some are not convinced yet

The Public Health Impact of Fossil Fuel Burning

If we think just a little more broadly about the burning of fossil fuels, we find a wide range of additional health issues to discuss.



Some of these issues are just now emerging but some are already very well described and have been harming our health for years.

The Public Health Impact of Fossil Fuel Burning

Mercury in Fish

Burning coal has filled our dwindling global fish stocks with a potent neurotoxicant (methylmercury)

This has created major problems in Public Health.



Should we eat fish?

Which ones?

How much?

Mercury in Fish

Burning coal spews mercury into the air. It then falls on the ocean, is converted to methylmercury, enters the ocean food chain, and gets concentrated in certain fish.

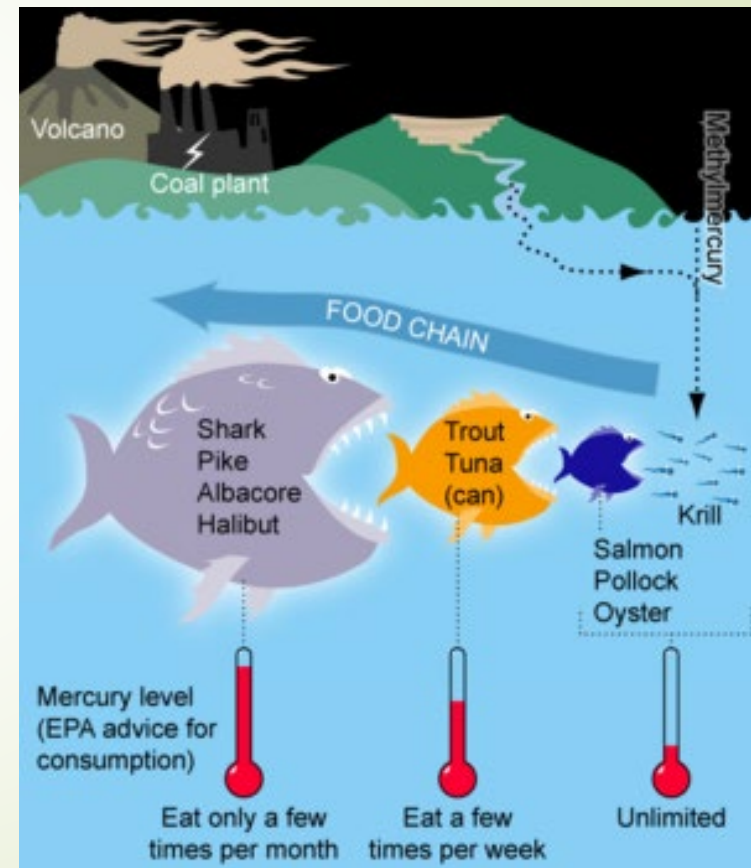
<https://www.whoi.edu/multimedia/mercury-cycle/b>

Fish are one of our key sources of omega-3 polyunsaturated fatty acids (DHA in particular) which are key for developing brains

Methylmercury is toxic to developing brains ...

Mercury in Fish

Thus, burning coal has injected one of the worst known neurodevelopmental toxins into one of our most important sources of neurodevelopmental nutrients



Mercury in Fish

Fish eating advice and advisories:

A near term necessity that distracts us from the fundamental drivers

Public Health Nutrition vs. Toxicology

We argue about who should eat, what amount, of which fish, how often . . . instead of emphasizing that coal has driven this problem.

Details:

<https://pubmed.ncbi.nlm.nih.gov/21211794/>

<https://pubmed.ncbi.nlm.nih.gov/18332715/>

<https://pubmed.ncbi.nlm.nih.gov/17047219/>

www.epa.gov/international-cooperation/mercury-emissions-global-context

<https://www.fda.gov/food/consumers/advice-about-eating-fish>

<https://www.fda.gov/media/102331/download>

https://epa.ohio.gov/portals/35/fishadvisory/fishadvisory_pamphlet.pdf

The Public Health Impact of Fossil Fuel Burning

Mercury in Fish

If we care about our children's brains

We should care about coal burning and fish

and of course . . .

we should also care about making sure that we harvest the ocean in a sustainable way

<http://pubweb.epa.gov/mercury/about.htm>

<https://www.youtube.com/watch?v=p6Jabn5rhtk>

Mercury in Fish

Local relevance:

Avon Lake NRG Power Plant

[https://www.gem.wiki/Avon Lake Power Plant](https://www.gem.wiki/Avon_Lake_Power_Plant)
<https://www.wkyc.com/article/news/local/lorain-county/what-do-you-think-about-the-avon-lake-coal-plant/95-545725804>



Still pumping mercury into the air and directly into the water as well (up to 389 million gallons of waste water into the lake every day) Discharge permits are renewed every 5 years after public comment . . . 2022 is next.

https://commons.wikimedia.org/wiki/File:Avon_Lake_power_plant.jpg

<https://www.cleveland19.com/story/705857/few-changes-on-states-annual-fish-eating-list/>

The Public Health Impact of Fossil Fuel Burning

Emerging Evidence: Ocean food web collapse

It turns out that CO₂ from fossil fuel burning is acidifying the oceans, and this may result in the disruption or collapse of ocean food chains. . .

leaving few fish to harvest anyway

<https://pubmed.ncbi.nlm.nih.gov/26460052/>

The Public Health Impact of Fossil Fuel Burning

Emerging Evidence: Ocean Food Degradation

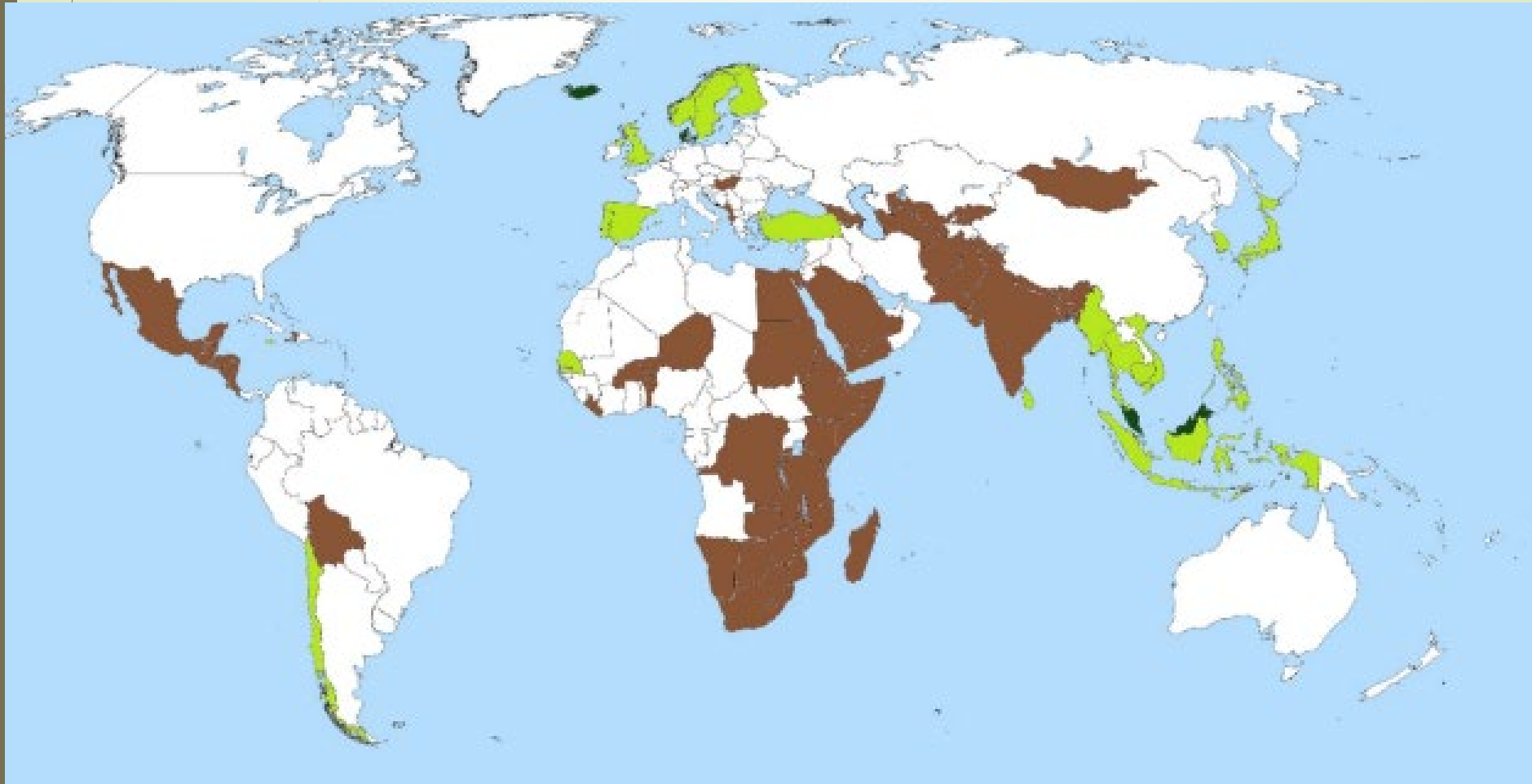
Global Evidence is now emerging that most humans do not eat enough Omega-3 (EPA/DHA) <https://pubmed.ncbi.nlm.nih.gov/33184396/>

and if we go full circle back to climate change

Warming waters alone are reducing the Omega-3 content of our global fish harvest (down 10-60% by 2100) <https://pubmed.ncbi.nlm.nih.gov/31512173/>

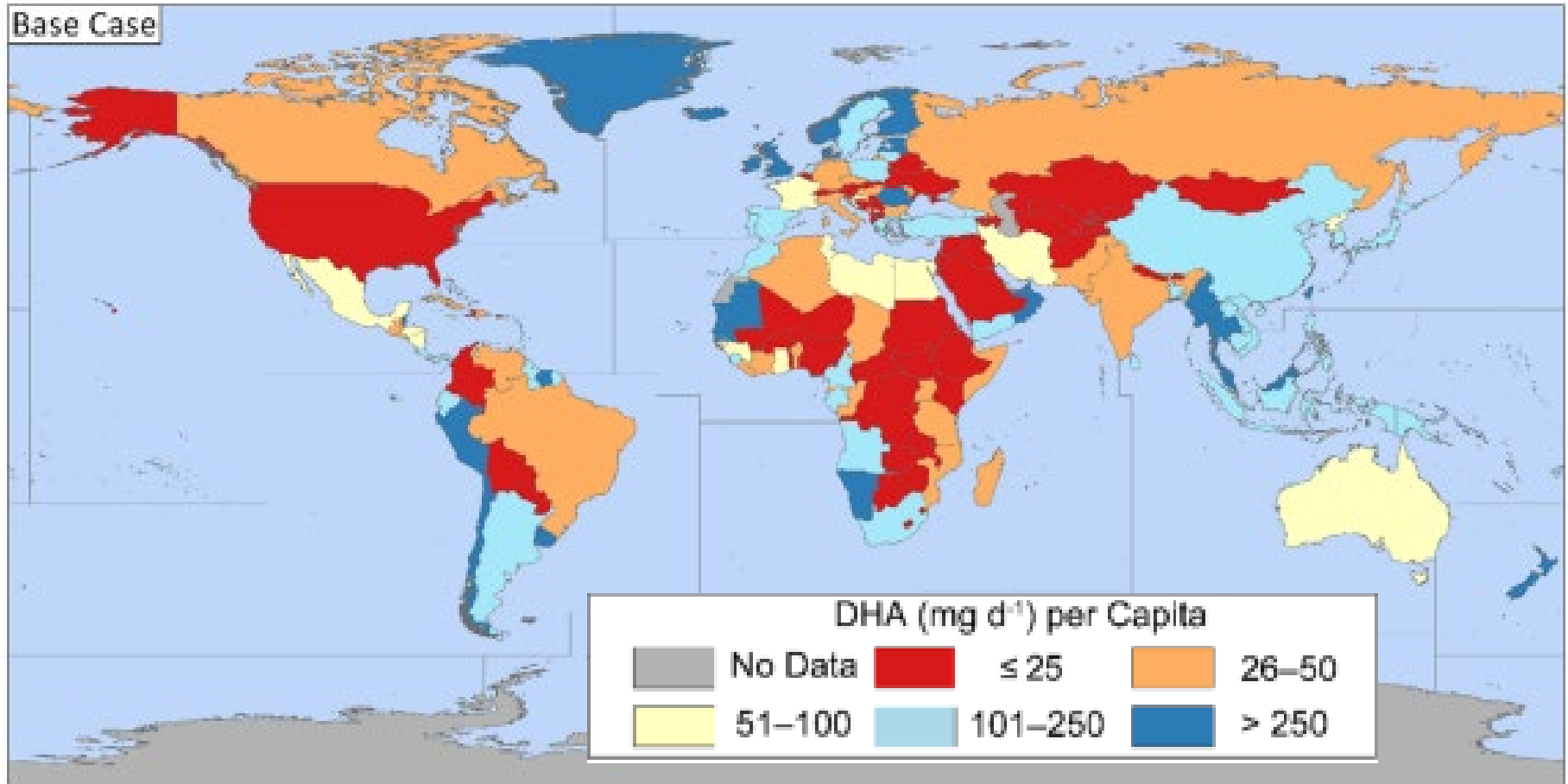
Ciesielski and Williams 2020

Countries with very insufficient average daily
Omega-3 intake in 2010 - labelled in brown

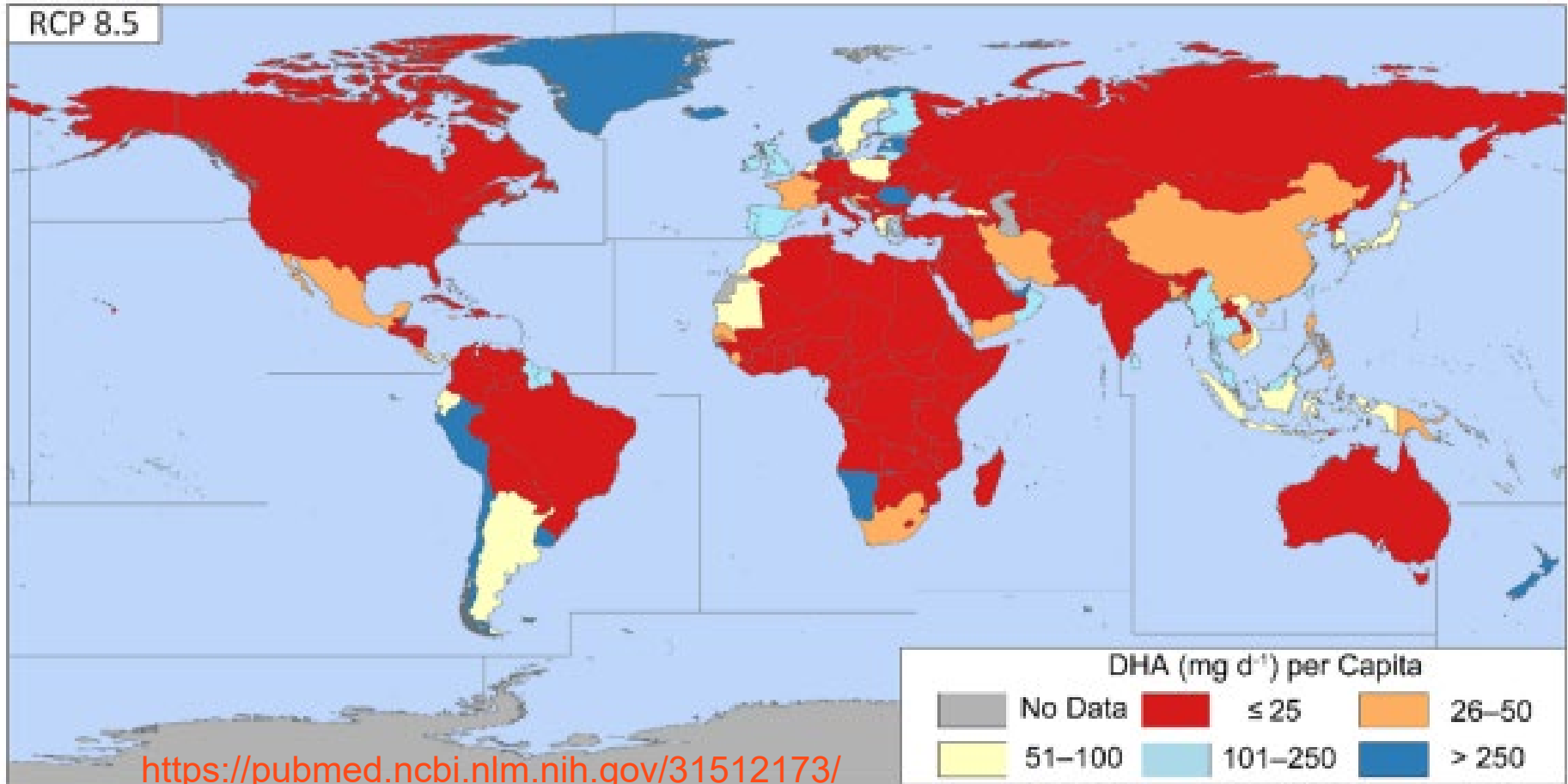


<https://pubmed.ncbi.nlm.nih.gov/33184396/>

Countries with very low per capita Omega-3 (DHA) production from fish in 2019 - labelled in red



Countries with very low per capita Omega-3 (DHA) production from fish in 2100 - labelled in red



And these dire estimates only reflect changes due to water temperature alone (homeoviscous adaptation). They do not account for overfishing and habitat loss etc.



If these findings are corroborated . . .



Where are we going to get the omega3?

Well . . . not likely from fish, but algae and terrestrial plants could be of great use here

If we keep burning coal we may:

- further raise the mercury content of fish
- lower the omega-3 content of fish
- run the risk of having no fish

and current estimates suggest that the habitual diets of most humans already fail to provide enough omega3

The Public Health Impact of Fossil Fuel Burning

Reduced nutrient content of plant based foods

Elevated CO₂ levels appear to decrease the nutritional content of plant based foods

and this can put people in some areas (parts of Africa), at risk for deficiencies (e.g. zinc deficiency).

<https://pubmed.ncbi.nlm.nih.gov/24805231/>

<https://pubmed.ncbi.nlm.nih.gov/26217490/>

<https://pubmed.ncbi.nlm.nih.gov/26189102/>

The Public Health Impact of Fossil Fuel Burning

Even if we ignore all of these negative effects we would still have to think about the adverse effects of coal burning on:

Respiratory Health

particulate matter (PM), sulfur dioxide (SO₂), oxides of nitrogen (NO_x) from coal burning are **linked to asthma symptoms, emergency room visits, increased susceptibility to viral respiratory infections, and lung cancer**

[https://noharm-uscanada.org/sites/default/files/documents-files/828/Health Effects Coal Use Energy Generation.pdf](https://noharm-uscanada.org/sites/default/files/documents-files/828/Health_Effects_Coal_Use_Energy_Generation.pdf)

The Public Health Impact of Fossil Fuel Burning

Additional effects of coal burning:

Cardiovascular Health

particulate matter (PM_{2.5}) from coal burning has been **linked to cardiovascular disease, atherosclerosis, and cardiovascular related deaths**

https://noharm-uscanada.org/sites/default/files/documents-files/828/Health_Effects_Coal_Use_Energy_Generation.pdf

The Public Health Impact of Fossil Fuel Burning

Additional effects of coal burning:

Adverse Pregnancy Outcomes

particulate matter (PM), sulfur dioxide (SO₂) NO₂, CO, and ozone from coal burning have been **linked to low birthweight, preterm delivery**

[https://noharm-uscanada.org/sites/default/files/documents-files/828/Health Effects Coal Use Energy Generation.pdf](https://noharm-uscanada.org/sites/default/files/documents-files/828/Health_Effects_Coal_Use_Energy_Generation.pdf)
<https://pubmed.ncbi.nlm.nih.gov/31195672/>

The Public Health Impact of Fossil Fuel Burning

The scale of the Public Health impacts of coal burning in China alone are staggering:

“Coal combustion in China’s power plants causes an estimated 250,000 deaths per year”

Scientific Evidence of Health Effects from Coal Use in Energy Generation

Erica Burt, MPH

Peter Orris, MD, MPH

Susan Buchanan, MD, MPH

https://noharm-uscanada.org/sites/default/files/documents-files/828/Health_Effects_Coal_Use_Energy_Generation.pdf

The Public Health Impact of Fossil Fuel Burning

Even if we put all of this aside . . .

We would still have to consider

the health issues,

injustices,

and costs associated with fossil fuel extraction

These could easily fill a second talk!

<https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2019/01/28/impacts-of-unconventional-oil-and-gas-industry>

<https://www.sciencedirect.com/science/article/pii/S1353829212001852>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6344296/>

https://sydney.edu.au/medicine/research/units/boden/PDF_Mining_Report_FINAL_October_2012.pdf

Fossil Fuel Extraction Occupations

“Working on site in the oil and gas extraction industry is inherently dangerous, with a fatality rate of 15.6 per 100,000 workers (four times higher than the overall rate among U.S. workers).”

“Beyond physical hazards, such as falls, published studies . . . have reported high concentrations of, and increased exposures to, airborne toxic chemicals that often exceed existing health standards or acceptable risk levels.”

<https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2019/01/28/impacts-of-unconventional-oil-and-gas-industry>
<http://www.bls.gov/iif/oshwc/cfoi/osar0018.htm>

Social and Environmental Injustice of Fossil Fuels

Who is willing to work in a coal mine?

Are they wealthy?

Can they afford a lawyer?

What other jobs are available in the area?

Who lives near the oil/gas extraction sites?
processing sites?
power plants?

Who lives near highways?

The Public Health Impact of Fossil Fuel Burning

Finally we have to consider the possibility that new extraction technologies can solve these problems . . .

Are Fracking and Natural Gas solutions?

No.

<https://www.nejm.org/doi/full/10.1056/NEJMp1913663>

Health and Environmental Hazards of Natural Gas.*

Category	Pathways and Mechanisms	Established and Potential Health Hazards
Local hazards		
Water contamination	Ground and surface water at gas wells is contaminated with fracking chemicals.	Many fracking chemicals are toxic: 25% are carcinogens; 75% are dermal, ocular, respiratory, and gastrointestinal toxins; 40 to 50% have toxic nervous, immune, cardiovascular, and renal effects; 30 to 40% are endocrine disrupters
Air pollution	Heavy trucks, construction equipment, and drill rigs emit diesel exhaust, oxides of nitrogen, and particulates; sand piles release silica dust; gas venting and flaring produce volatile organic compounds (benzene, 1,3-butadiene, and formaldehyde).	Exacerbation of asthma and COPD; increased risk of cardiovascular disease and diabetes; increased risk of prematurity and low birth weight; volatile organic compounds increase risk for leukemia and lymphoma
Noise pollution	Heavy equipment and gas flaring generate nearly continuous noise; sound levels can reach 70 A-weighted decibels, which exceeds EPA community guidelines.	Sleep disturbance; stress (associated with increased cardiovascular disease risk); cognitive deficits in children
Light pollution	High-intensity illumination and gas flaring generate bright light day and night	Sleep disturbance; stress
Radionuclide releases	Some shale formations contain naturally occurring radionuclides such as radon, principally in Pennsylvania and Texas.	Cancers, chiefly lung cancer
Earthquakes	Seismic activity is increased near fracking sites and up to 30 miles away.	Injuries; anxiety; loss of property value
Community disruption	Poor and minority communities are disproportionately exposed to noise, toxic chemicals, and explosion hazards.	Mental health problems; substance abuse; sexually transmitted diseases
Regional hazards		
Fires and explosions	Pipeline explosions occur every year in the United States and recently occurred in Armada Township, MI; Refugio, TX; Salem, PA; Watford City, ND; and Merrimack Valley, MA.	Injury; death
Air pollution from gas combustion	Gas combustion in stoves, boilers, and furnaces generates oxides of nitrogen.	Increased asthma risk; exacerbation of COPD and cardiovascular disease
Global hazards		
Contributions to climate change	Use of natural gas causes methane leakage and gas combustion generates carbon dioxide.	Heat waves; extreme weather events; droughts; floods; wildfires; expanded ranges of vectorborne diseases; compromised food supplies resulting in famine, migration, conflict, and mental distress

<https://www.nejm.org/doi/full/10.1056/NEJMp1913663>

Total Public Health Impacts of Fossil Fuel Based Energy


These impacts are enormous and can't be easily estimated

The more we look, the more consequences we find, and the more we realize that none of us is immune from the health problems associated with burning fossil fuels.

Total Public Health Impacts of Fossil Fuel Burning

Maybe if we start to talk more broadly about the immediate and personal human health impacts . . .

people will see that the health of their family and friends are at stake right now.



This may spur people to engage, discuss changes, and act.



Ok that's the evidence, now
what do we do with it?

My Take:

If we do not learn to act sustainability:

we will continue to hurt ourselves

in a large variety of ways

and we may create problems that we can't fix



But it is totally possible to change and we can do it

new clean sustainable technologies are
almost ready to provide us with the
power we need

We need to encourage our government
and our industries to bring them into the
mainstream ASAP

<https://www.sciencedirect.com/science/article/pii/S0301421510008694>

<https://www.sciencedirect.com/science/article/pii/S0301421510008694>

https://www.nature.com/news/polopoly_fs/1.14873!/menu/main/topColumns/topLeftColumn/pdf/507300a.pdf



Other thoughts about the evidence?

Other opinions and ideas about what to do with the evidence?

Thank you for your attention, and for the chance to meet with you today.

Assuming a well-paying replacement job could be found for everyone working at the Avon Lake coal fired power plant

Could it be closed?

Who would like to conduct natural experiment studies (pre vs. post plant closing)?

For the folks living nearby . . .

Would ER Asthma visits go down?

What about MI/Stroke?

What about low birth weight and preterm birth?

Review Questions

If you care about brain health and child development you should care about sustainable energy practices.

a. true

b. false

Why?

Burning fossil fuels has contaminated our global fish supply with mercury. Mercury is toxic to developing brains.

In addition to the contamination of fish with mercury, what is another way that the use of fossil fuels threatens our ocean-based food supply?

Excess CO₂ acidifies the ocean.

This harms many forms of life that produce calcium carbonate shells (like plankton). Since many other animals eat plankton, ocean acidification could disrupt ocean food webs, and cause a catastrophic collapse of our fish supply.

Does the burning of fossil fuels impact our plant-based food supply?



a. yes

b. no

How?

Elevated atmospheric CO₂ reduces the nutritional content of plant based foods. In particular it is known to lower the zinc content of some plant based foods. This is critical in regions of the world where the local diet supplies low levels of zinc (parts of Africa).

Fossil Fuel Burning is known to increase the incidence of:

- a. Respiratory Conditions (asthma exacerbations, emergency room visits, increased susceptibility to viral infections)
- b. Cardiovascular Conditions (atherosclerosis, Cardiovascular related deaths - such as heart attacks)
- c. Lung Cancer
- d. Low Birth-weight
- e. none of the above
- f. all of the above

Which of these health effects are completely mediated by changes in climate?

- a. Respiratory Conditions (asthma exacerbations, emergency room visits, increased susceptibility to viral infections)
- b. Cardiovascular Conditions (atherosclerosis, Cardiovascular related deaths - such as heart attacks)
- c. Lung Cancer
- d. Low Birth-weight
- e. none of the above
- f. all of the above

These effects have been happening.
These effects continue to happen.
They would happen even if the
climate did not change.

Other Resources

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

<https://poweringhc.org/conference/>

<https://pubmed.ncbi.nlm.nih.gov/31195672/>

Occupational Exposures at Fracking Sites

respirable silica

nitrogen oxides

sulfur dioxide

particulate matter

formaldehyde

heavy metals

carbon monoxide

volatile organic compounds (e.g., benzene, trimethyl benzene, xylenes, aliphatic hydrocarbons, and polycyclic aromatic hydrocarbons)

ozone

methane

hydrogen sulfide (sometimes deadly) . . . etc.

<https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2019/01/28/impacts-of-unconventional-oil-and-gas-industry>

<http://www.bls.gov/iif/oshwc/cfoi/osar0018.htm>

In addition to the health effects of fossil fuel burning that are already present today, please name some of the climate mediated effects that we expect to see much more of in the near future:

- a) more frequent severe weather events (these come with injuries, illnesses, and deaths)
- b) the quality or quantity of water supplies in some areas are expected to decrease and which may lead to deprivation and civil conflicts
- c) the number of heat related deaths will likely increase
- d) disease carrying insects are expected to further expand their geographic ranges (i.e. the Anopheles mosquito may spread north and take Malaria with it)