

Energy and Human Health

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Basic Biomedical Research Methods and Environmental Policy

- Single compound exposures in inbred animal models are primary research tool for environmental health research.
- Current risk assessments focus on component exposures, leading to policy recommendations for single pollutants.

MeHg as an example

What You Need to Know About Mercury in Fish and Shellfish

U.S. Food and Drug Administration and
U.S. Environmental Protection Agency
Advice for

Women Who Might Become Pregnant, Women Who Are
Pregnant, Nursing Mothers, and Young Children

1. Do not eat:
 - Shark
 - Swordfish
 - King Mackerel
 - Tilefish

They contain high levels of mercury.

2. Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury.
 - Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.
 - Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.
3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers and coastal areas.

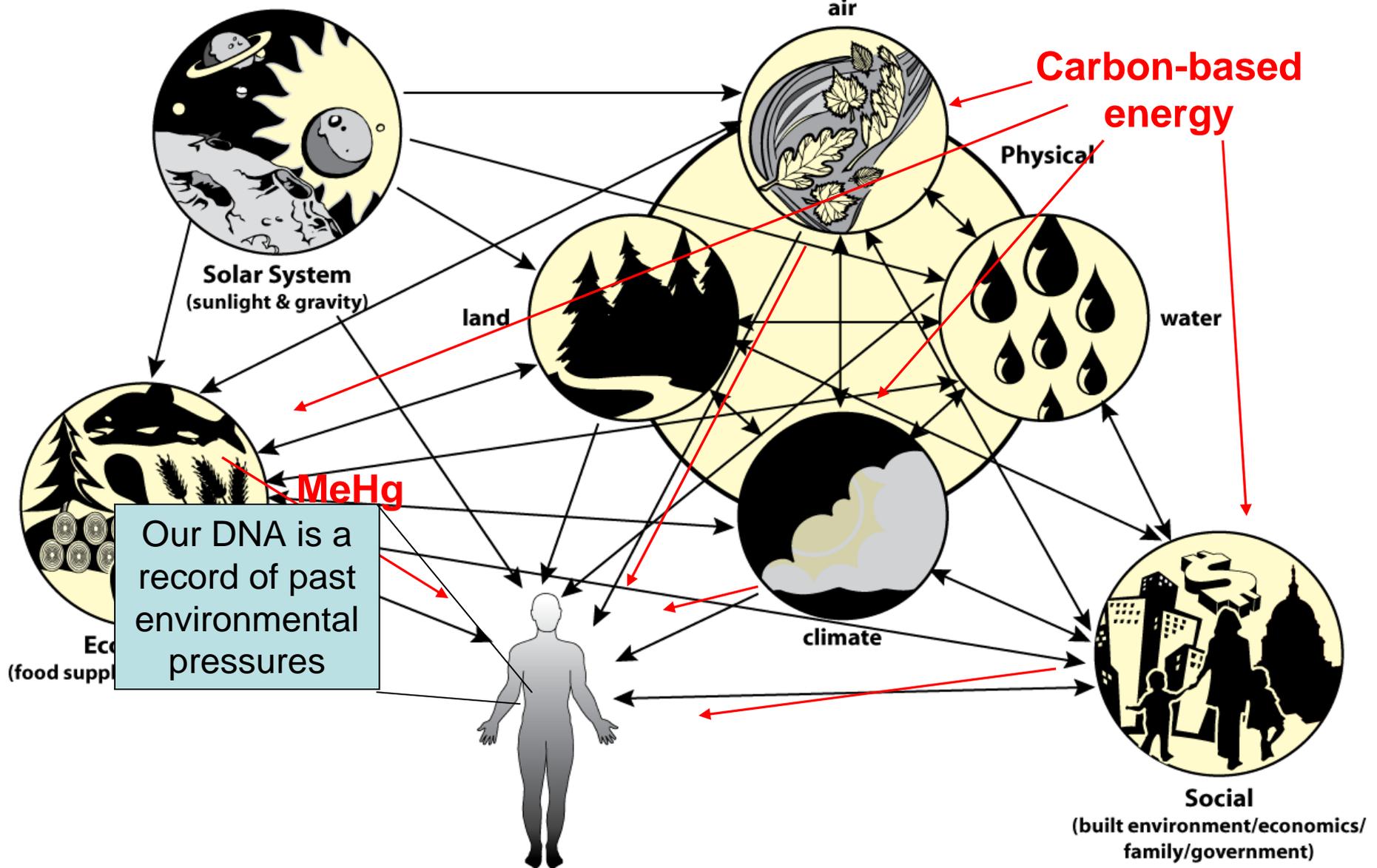
If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week. Follow these same recommendations when feeding fish and shellfish to your young child, but serve smaller portions.

For more information, please visit:
www.epa.gov/waterscience/fishadvice/advice.html
(See full text of Joint Fish Advisory in Appendix A)

- A large portion of the world's population does not have the luxury of choosing which fish to eat (McMichael and Butler 2005; Tuomisto et al 2004).
- Neglects systemwide effects on resource depletion caused by overfishing of particular species (Sala and Knowlton 2006).

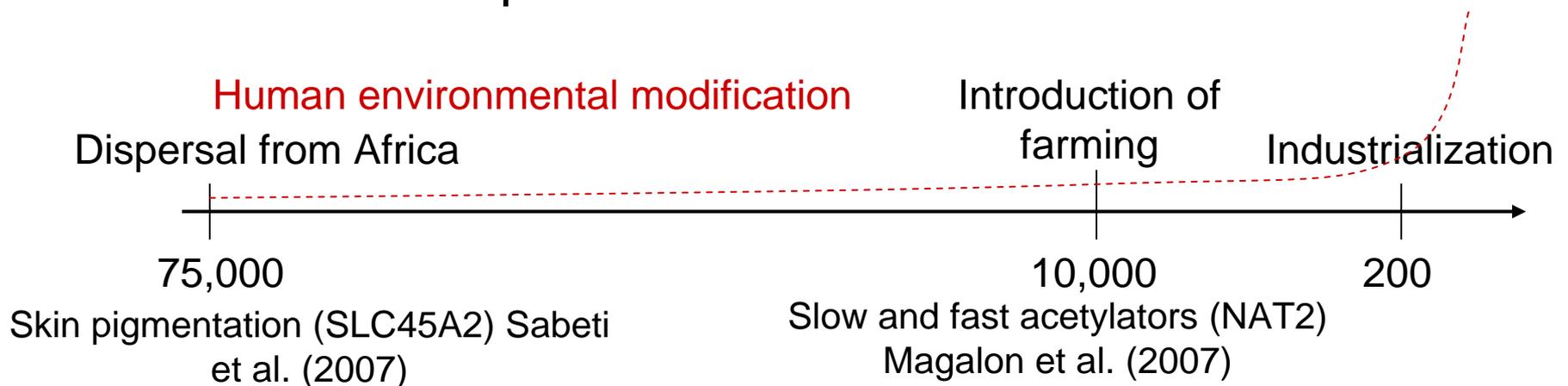
**Policies focused on single pollutants
may not provide long-term
sustainable solutions to certain
environmental health threats.**

Framework for a systems approach to human health research

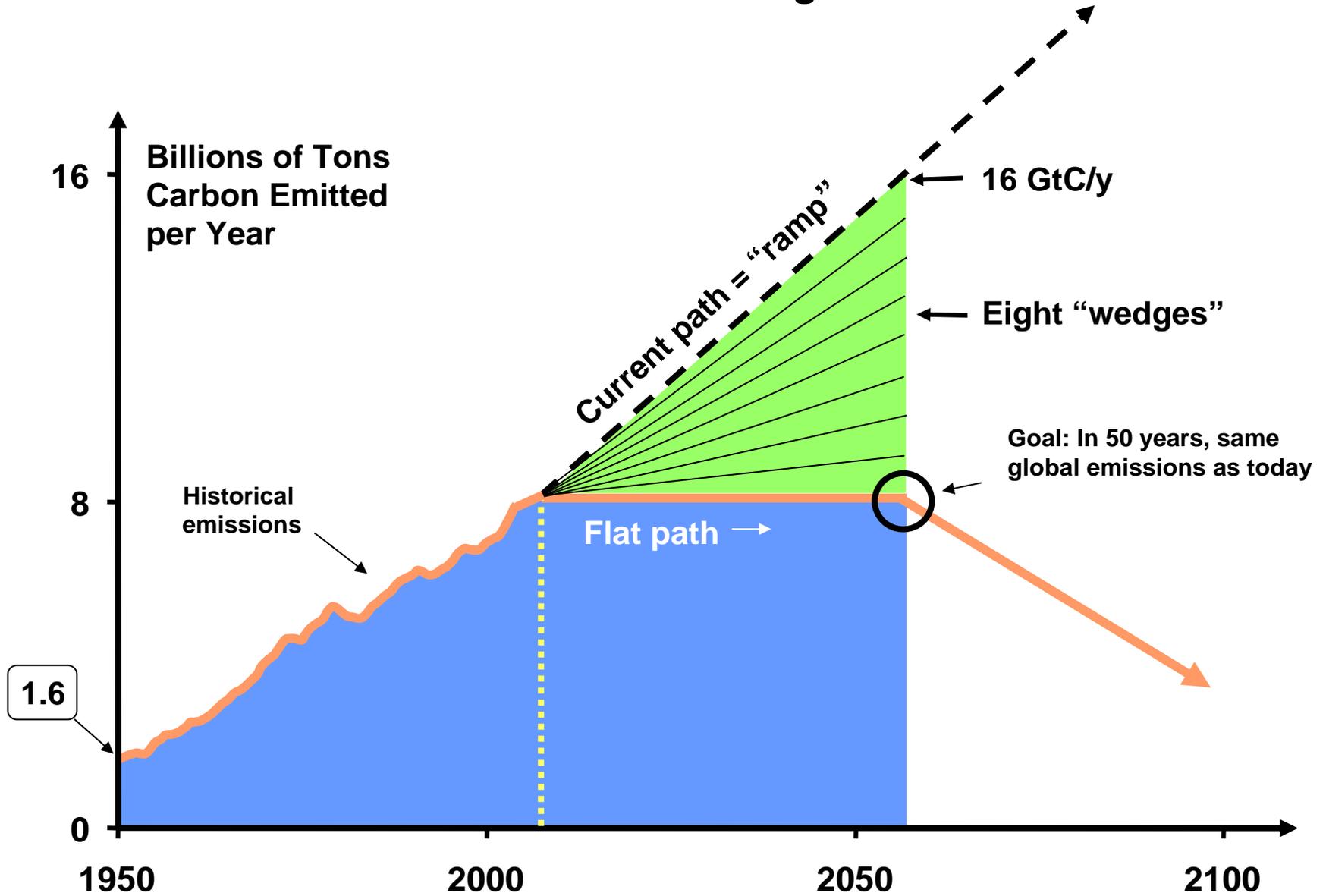


Genetics or Environment ..its just a matter of timescale

- Population genetics can tell us how humans have reacted to past environment pressures via positive selection of genetic material on an evolutionary time scale.
- Today, we have a DNA record of past environmental pressures, which we can mine to learn about current environmental pressures.



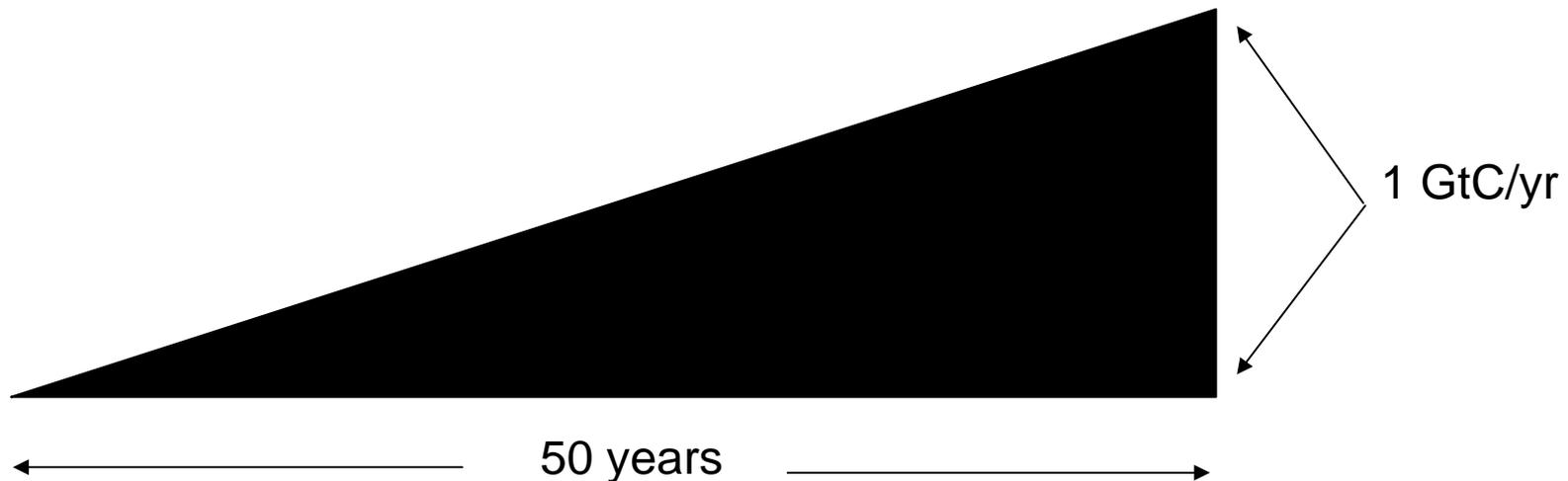
Stabilization Wedges



"Stabilization Wedges: Solving the Climate Problem for the next 50 Years with Current Technologies," S. Pacala and R. Socolow, *Science*, August 13, 2004.

What is a “Wedge”?

A “wedge” is a strategy to reduce carbon emissions that grows in 50 years from zero to 1.0 GtC/yr. The strategy has already been commercialized at scale somewhere.



Cumulatively, a wedge redirects the flow of 25 GtC in its first 50 years. This is 2.5 trillion dollars at \$100/tC.

A “solution” to the CO₂ problem should provide at least one wedge.





Solar Electricity

**Install 20,000 square kilometers for
dedicated use by 2054**



Photos courtesy of DOE Photovoltaics Program

A wedge of solar electricity would mean increasing current capacity 700 times

E / \$\$\$



Biofuels

Scale up current global ethanol production by 30 times



Photo courtesy of NREL

Using current practices, one wedge requires planting an area the size of India with biofuels crops

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Energy Independence and Security Act of 2007

- Renewable Fuels Mandate: Requires fuel producers to use at least 36 billion gallons of biofuel in 2022 (6 fold increase over current levels).
 - Since 2001, ethanol production has quadrupled from 1.6 billion gallons in 2000 to an estimated 6.4 billion gallons in 2007, with the vast majority coming from corn.
 - **Health Issues**: 1. Rising food prices leading to hunger and political unrest in developing countries. 2. Ethanol combustion by products lead to air pollution with different health impacts
- Lighting Efficiency Mandate: phase out the use of incandescent light bulbs by 2014, and improve lighting efficiency by more than 70 percent by 2020.
 - **Health Issues**: Compact fluorescent lightbulbs contain mercury, which if not recycled properly could become a human health issue. Most concern is for waste disposal workers.

Nuclear Power 2010 program

- This program has resulted in six applications to build and operate new nuclear plants in the U.S., with another 13 applications expected to be submitted this year.
- Health Issues: Radiation exposure. Currently no solution for long-term storage of waste. Water usage, ecological impacts, terrorist target.

Solar technology

- The manufacture of PV panels requires the mining of silicon dioxide from sand or quartzite and reduced with heat to pure silicon. Materials released and inhaled during refining are the main health risks.
- New manufacturing process uses cadmium telluride thin film rather than the more expensive crystalline silicon.

Questions for discussion

- What are the human health research challenges for sustainable and safe utilization of 36 billion gallons of biofuel by 2020?
- What are the most promising alternative energy technologies in which potential human health implications have not been fully evaluated?
- How can the NIEHS knowledgebase in areas of toxicology and gene-environment interaction research be mined to address health effects of energy systems?
- How can environmental health scientists better capture interactions between social, ecological, and physiological components of health?

