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At the National Academies' Science Museum!

Climate Change: An Inter-Generational Hot Potato

What is the Long Term Future of Climate Change?

Synopsis of the March 2005 WFS Washington DC Chapter dinner program at the National Academies' Marian Koshland Science Museum, presented by Dr. Peter Schultz; summarized by Dave Stein and Russell Wooten (see related article, "Koshland Science Museum," to learn more about the museum).

Are the projected large climate changes the maximum that we will see or only the beginning? Can the Earth's climate "snap" suddenly, unlike anything previously observed? Can a much warmer climate remain for centuries even if greenhouse gas emissions are stopped? How does the economists' utility function relate to investments in environmental cleanup? And, what tough tradeoffs lie ahead, such as saving coastal homes vs. allowing the wetlands to grow inward – a tradeoff that can impact the reinsurance industry?

There is generally little discussion in the popular media about what might happen to the Earth's climate beyond the year 2100. At the US National Capital Chapter program in March 2005, Dr. Peter Schultz discussed very long-term climate change – shifts that transcend political and even generational timescales – and the particular challenges in maintaining a long term view on climate issues. Drawing on his own research and that of others in the fields of carbon cycle dynamics, climate modeling, and macroeconomics, Dr. Schultz contrasted the standard picture of climate change as traditionally reported.

The program was presented in three parts: (1) What's going on at the scientific front lines?, (2) Why is global warming an intergenerational hot potato?, and (3) What can we do to cool the potato?

THE SCIENTIFIC FRONT LINES

Dr. Schultz started by presenting the following scientific facts:

1. 2004 was the fourth warmest year on record.

2. There has been a general global warming trend from 1880 to the present.

3. The general scientific consensus is that most global warming is the result of human actions.

4. Global warming is not uniform. There are localized anomalies of cooling, primarily in western Russia, Alaska, and the Yukon.

5. All the oceans are warming. The actual temperature increase is small and involves only the upper ten meters of the ocean, but the impact is substantial because of the colossal mass of water involved.

6. There are two positive feedback loops that intensify the effect of global warming:

a. Ice is reflective. As ice melts, less solar radiation is reflected, resulting in more global warming. The year 2002 recorded the smallest amount of sea ice on record. Atmospheric circulation most likely controls the melting of ice. However, the thickness of the ice is also decreasing, and this may have a more significant impact.

b. Water vapor, a greenhouse gas, is more significant. Warming puts more water vapor into the atmosphere, which traps more radiation, in turn leading to further warming.

7. Computer models predict that the combined impact of these two mechanisms can result in extreme climatic events. However, even the most powerful computers don't predict near term weather phenomena, such as hurricanes, all that well. This is because many small scale processes are involved that computer models are not properly accounting for. Nonetheless, indicated Schultz, current short term weather models predict that the incidence of severe hurricanes will increase, partly as a result of higher sea surface temperatures as discussed above.

8. The Earth's annual "breathing" process is the annual greening of the two hemispheres during their respective spring seasons. Carbon dioxide levels drop during the northern hemisphere summer, explained Schultz, because the northern hemisphere has a larger land mass with more trees to soak up the CO_2. But the planet is now "breathing harder." A century ago, the East coast of the United States was virtually denuded and little old growth remains. New vegetation there has helped keep CO_2 levels down, but this re-growth has virtually tapped out.

9. An ocean desert appears during the southern hemisphere summers off the Pacific coast of South America. The desert results from the cyclical lack of key nutrients, specifically phosphorous, nitrogen, and iron. Scientists have pumped rust into this ocean desert to initiate a "bloom" of marine life to extract the CO_2, but the results of this experiment were not conclusive. To extract CO_2 from the atmosphere, the marine life that absorbs the CO_2 must sink down into the depths of the sea, since otherwise the marine life will eventually decompose near the surface, releasing the CO_2 back into the atmosphere.

WHY AN INTER-GENERATIONAL HOT POTATO?

Noting several common excuses including "It's not my problem," "I have a wife and two cars to feed," "I don't trust the UN," and "How good is the science?" – Dr. Schultz provided the following reasons as to why global warming is an intergenerational as well as an international issue.

1. Atmospheric CO_2 has a long lifetime.

2. Global warming is a delayed reaction. If all greenhouse gas emissions stopped today, global warming would continue. The duration of atmospheric CO_2 is presently 30 years. Eventually CO_2 will saturate the oceans and the biosphere. Half a millennium from now, the lifetime of atmospheric CO_2 may become as high as 300 years. Even if emissions are held constant at the 2000 levels, sea levels will rise because of melting ice and also because water expands as it warms. For these reasons, we are already committed to future warming.

3. Cost-to-benefit analyses used by economists generally discount the future, typically using a fixed exponential discount ratio. The rationale is that investment tradeoffs must be considered, for example, "Do you invest in environmental cleanup or do you put the same funds into the stock market so that they may grow?" This assumes that global warming is reversible and/or that substitutability is possible. This assumption leads us first to invest in the stock market (the economy) to let the money grow, and then to invest some of the funds in cleanup after they have grown. If a 3% discount rate is used, the present value of anything drops to 5% of its present value after 100 years and to virtually 0% after 200 years. By this analysis, fixing the global warming problem is not a wise investment with today's money. Economists generally prefer to invest in a way that maximizes the utility function. Even if the present generation commits itself to fixing the global warming problem, commitments by successive generations are also needed to avoid backsliding. The good news is that pollution reduction, although implemented for other reasons, will also help mitigate global warming.

4. The political cycle is short.

5. The business cycle is even shorter than the political cycle.

6. This problem will affect the poorest people, who live closest to the sea.

7. This problem will affect those areas and people who live furthest from its source.

8. Global warming is very different from the other environmental problems. For example, the thinning of the ozone layer is a problem, but the economy doesn't depend on CFCs.

9. Solutions demand international cooperation. China has the world's largest population as well as the world's largest coal resources.

10. Scientific uncertainty is always present. Even so, most global warming that took planet Earth from the ice age to the present happened in less than ten years, and this was before there were humans to pump greenhouse gases into the atmosphere. However, conditions were different them. Even so, an ice age can happen suddenly and can dissipate suddenly.

COOLING THE POTATO

Quick to state that there is no silver bullet, Dr. Schultz discussed several areas and venues for action:

1. State and local action – climate change action plans, building codes, and incentives for alternate energy sources, all of which are measures similar to those in the Kyoto Protocol.

2. "Carrots and sticks" – financial incentives or tax penalties, to motivate industry leaders to reduce emissions and to generate cost savings through efficiencies, coupled with positive public relations, pressure from insurers, and threats of lawsuits.

3. Pressure from shareholders, to reinforce the "carrots and sticks."

4. Sensible national energy strategies – research investments, reduction of oil and gas subsidies, subsidies for low or no-carbon energy sources, improved fuel economies via subsidies for hybrid vehicles, and a tax on gas guzzlers. All of these may be more attractive options as oil prices increase.

5. Carbon caps and cap-trading, with caps being generous at first to avert pressures to implement inefficient measures and with a robust cap trading system.

6. Carbon sequestration (removing it from circulation), via tree planting and low- or no-till agriculture, with trees providing the additional benefit of shade. The shade value continues even after the tree reaches maturity and no longer effects a net removal of CO_2.

7. Climate-friendly cooperative efforts with developing nations – technology transfer, clean development, and carbon sequestration – especially since it may be less expensive to pay other nations to plant trees than to pay for them to be planted in the US.

8. Reduction of other emissions on which our economy doesn't depend, since CO_2 is only half of the problem. Methane produced by livestock, landfills, and rice paddies as well as nitrogen oxides also threaten the stability of our climate.

9. International engagement; starting modestly, and building trust.

10. Energy conservation; public awareness, with both bottom-up and top-down efforts.

***Peter Schultz**, Ph.D. is the Associate Director for Science Integration at the Climate Change Science Program Office (Incorporating the U.S. Global Change Research Program and the Climate Change Research Initiative). Previously, he was the Exhibits and Public Programs Director for the Koshland Science Museum, overseeing the creation of the Global Climate Change display in the museum. Before joining the National Academies, Peter conducted research on the relationships between vegetation patterns, temperature, and precipitation at the National Oceanic and Atmospheric Administration. Dr. Schultz invites you to visit the Koshland Science Museum's website on the climate exhibition: www.koshland-science-museum.org/exhibitgcc/index.jsp.*

***POINTS FOR THE CLASSROOM** (send comments to forum@futuretakes.org):*

- *Cast yourself in the role of a key policy advisor to the President of the United States or (for our international readers) your own head of state. What public sector investment tradeoffs between climate change mitigation and other social needs – for example, education, healthcare, or infrastructure – do you recommend, and why? What courses of action (COAs) do you recommend for international engagement?*

- *You're not finished yet! What alternatives or extensions to the economists' utility function can make investments in climate change mitigation more attractive? Is there a way to incorporate the "cost of regret" in economic models, particularly in light of the recent tragedy in New Orleans, Louisiana (USA)? Will an alternative utility function lead to a new economics, and if so, what will be its characteristics?*

- *Likewise, will a longer business or political cycle emerge to address climate change and similar long-term issues? Why or why not?*

- *Will countries with longer term political and business cycles better withstand the forthcoming climatic changes that some experts anticipate?*

- *Finally, can you propose any additional "cooling the potato" incentives?*