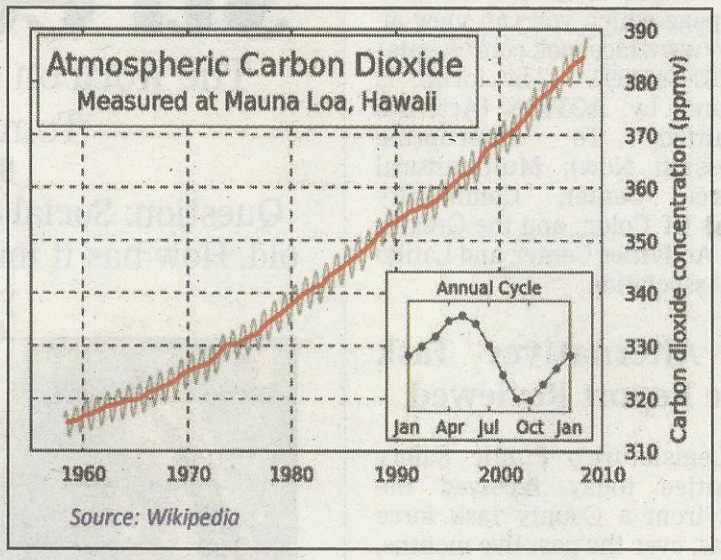
Volume 8, No. 43 • August 18-24, 2014

The Keeling Curve and Global Warming

By Richard W. Franke

This is the latest installment in our Signs of Sustainability series, organized by Sustainable Tompkins. Visit them online at www.sustainabletompkins.org.



Source: Wikipedia

In 1946 the U.S. Navy sent Commander and oceanographer Roger Revelle to the Bikini Atoll in the Western Pacific to study the possible effects of atomic weapons testing on the corals in the lagoon. Among other research over the next ten years, Revelle tried to calculate the amount of carbon in the water. Around 1956 he came to a startling conclusion: The complex set of chemicals in seawater was balanced in a way that made it likely that as CO2 molecules were absorbed from the atmosphere, they would push other CO2 molecules back out, or they would be prevented from being absorbed.

Revelle realized immediately that his conclusion had enormous significance for Earth's atmosphere as well as for the oceans. Back in 1859, the Irish physicist John Tyndall had discovered that CO2 in the atmosphere had the effect of reflecting some solar heat back to the Earth's surface—the "greenhouse effect." In 1895, the Swedish chemist and mathematician Svante Arrhenius had calculated that while increases in CO2 would indeed have a greenhouse effect, this effect would not be felt for about 2,850 years because most of the CO2 would be absorbed in the oceans. Arrhenius was a genius at complex calculations, but he had made assumptions about the chemical makeup of the oceans that now appeared to be incorrect. Revelle's studies suggested that the oceans would take up only about one-tenth of the carbon that Arrhenius had assumed.

Along with his scientific talents, Revelle is considered an outstanding administrator and one who could identify others with promise. One of those was a young chemist named Charles Keeling, whom Revelle helped get funding in connection with the 1957–58 International Geophysical Year to take baseline measurements of CO2 in the atmosphere on top of the Mauna Loa volcano in Hawaii and at a research station in Antarctica.

Keeling had already established himself as a valuable colleague—if somewhat quirky—in May of 1955 by camping with his family at Big Sur and taking a series of CO2 measurements with a device he had himself invented. Keeling's measurements were nearly as astonishing as Revelle's ocean-chemistry results. While other researchers had found wildly varying CO2 readings in various locations around the globe, Keeling guessed that their instruments were faulty and that they had not been able to control for intervening factors such as winds bringing in factory emissions. Using his newly invented measuring device, Keeling showed that CO2 levels in the air around Big Sur, Yosemite, the Sierra Nevada and other locations were a constant 310 parts per million (ppm), at least when taken over a short time period. His results strongly supported the view that there is essentially a single CO2 number for the atmosphere over the entire planet. Among geophysicists and other scientists, this was big news.

But Keeling's greatest discovery was yet to come. In 1960, Keeling reported that his Antarctic-site measurements of two full years indicated that CO2 levels in Earth's atmosphere were rising. Amazingly, his measurements showed that the increase was almost exactly what would be predicted if Revelle's calculations about ocean absorption were correct and Arrhenius' calculations were altered to correct his assumptions about ocean absorption.

Funding problems forced Keeling to drop his Antarctic measurements, but the Mauna Loa CO2 readings have continued to this day (with one small funding-induced break in 1964; Speart 2003:37). Year by year, season by season, Charles Keeling measured the CO2 concentration as it rose from 310 when he began to 380 in 2005, the year he died. Others, including one of his sons, continue the work, as do people at other research stations around the world. The Keeling Curve, as it is now known, is one of the most famous discoveries in modern science. [Source of the Keeling Curve graphic: Wikipedia]

Richard W. Franke writes about the history of sustainability. He is professor emeritus of anthropology at Montclair State University, a resident of Ecovillage at Ithaca and a board member of Sustainable Tompkins.