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Subject: "Dr. Jeffrey S. Gaffney's Written Testimony"
Sun, Nov 6, 9:21 AM

I am a retired Ph.D. environmental and atmospheric chemist. During my career, I held positions as Senior Chemist at three of the Dept. of Energy National Laboratories (Brookhaven, Los Alamos, and Argonne) from 1975-2006, where I was involved in atmospheric chemistry and climate change research activities. My most recent position was at the University of Arkansas at Little Rock (2006-2016) where I was the lead mentor for the DOE Global Change Education Program. I also chaired the review panel for the First Triennial Report to Congress on Biofuels and the Environment. This document was published in 2011. The second report published in 2018 essentially found the same results, that the combustion of biofuels had a negative impact on the environment. In 2006, I was the Lead Scientist for the DOE portion of the MILAGRO project that was a collaborative research effort in Mexico City examining air quality and impacts of megacities on greenhouse gases and aerosols on the environment and ultimately climate forcing.

I co-authored a textbook in 2020- Chemistry of Environmental Systems: Fundamental Principles and Analytical Methods published by Wiley. This book covers a lot of material on how the earth systems work and how they are impacted by pollution - both in air and water. Chapter 11 covers climate change and most all its impacts, mitigation strategies, as well as the need for life-cycle analyses of the various energy options to better determine overall GHG footprints. Chapter 13 covers sustainability, the need for non-fossil energy sources, and a comparison of various energy options, including nuclear, wind-power, hydro, solar, etc. as options, noting that both air quality improvement and GHGs emissions would be reduced if combustion energy sources are reduced - especially fossil fuels. A lot of the material we used in these analyses came from the IPCC and federal agencies, including the EPA, so I know that they EPA is aware of the issues and impacts.

I believe that it is now self-evident that the types of climate change impacts predicted by the IPCC are currently happening and will continue for decades. These include many impacts that are discussed in our textbook and I will not attempt to cover them here, as I know EPA is very aware of the impacts of GH forcing species. Climate change is real, and should not be ignored any longer, and that anthropogenic greenhouse gas emissions from fossil fuel sources are the major contributor. That said, coal fired power plants are one of the main contributors as noted in our textbook and in a review article I co-authored in 2009, See: Jeffrey S. Gaffney and Nancy A. Marley, "The Impacts of Combustion Emissions on Air Quality and Climate: From Coal to Biofuels and Beyond" Atmos. Env. 43, 23-36 (2009). Coal fired-power plants also emit mercury along with other air pollutants also a noted EPA concern.

The U.S. and global leaders still need to finally recognize this and implement investments in infrastructure to move as quickly as possible towards electric vehicles, and clean alternative power generation to limit any further large increases in GHG emissions, which will make it even worse. Fossil fuels are not renewable, and we need to wean ourselves off of them for many reasons, including energy independence. Along with many other scientists, I think that nuclear energy is likely one of the best candidates, along with wind and solar power - though it will take a lot of work and money to change the out the existing infrastructure to the improved technologies. Note that we have not trained nuclear chemists and engineers in the US for quite sometime, and educating the needed nuclear scientists and

engineers will be needed. France is in a much better situation than we are with regard to nuclear power. I would note that Poland recently announced that it will be constructing new nuclear power plants to improve their energy security and that the plants will be constructed by Westinghouse. Indeed, the war in Ukraine is causing the EU and Great Britain to move faster towards establishing renewable energy and ultimately getting them free from relying on foreign fossil fuels.

I believe that adaptation will be needed that will require changes in state and federal building codes to handle severe weather events, better planning for handling freshwater shortages, increases in power demands for hotter summers, drought and heat resistant crop development, and so-on. Basically, our infrastructure needs to be rebuilt! And that will take and time and money, and the will to do it. The recently passed bill to begin to rebuild infrastructure is at least a start in this direction.

Mitigation strategies that try to remove the GHGs after they have been emitted to the atmosphere are too costly, and just do not work, considering the size of the troposphere and the low concentrations involved. I am also against geoengineering solutions to climate change due to the huge cost and enormous uncertainties in how they would impact the whole earth system. We covered this also in our book in Chapter 11. Thus, controlling the emissions at the sources is the best option, if renewable energy replacement is not possible.

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