Clean Water and a Warming Planet: Are Low-Level PFAS Regulations and Greenhouse Gas Reduction Goals Compatible?

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Background/Objectives. PFAS drinking water standards are continuously evolving at state and Federal levels, propelled by an expanding body of toxicology data. At the same time, many states and the EPA have been advancing initiatives to reduce greenhouse gas (GHG) emissions. The primary treatment mechanism for PFAS in drinking water is granular activated carbon (GAC); GAC is produced from coal or high-temperature treatment of biomass and has a quantifiable, non-trivial GHG footprint. The project team conducted an evaluation, using the State of Maine as a model domain, that involved modeling and calculation of GHG footprint associated with removal of PFAS from drinking water. The overarching objectives of this evaluation include (a) ensuring that environmental footprint is not overlooked in state/Federal discussions on PFAS water treatment goals, and (b) providing an initial framework through which such considerations may be applied in these discussions.

Approach/Activities. The project team developed model calculations of GAC requirements to reduce six PFAS compounds to a range of target treatment concentrations. The six modeled PFAS compounds include PFHxS, PFHpA, PFOA, PFOS, PFNA, and PFDA (i.e., carbon chain lengths ranging from 6 to 10). The model incorporated drinking water target concentrations ranging from 2 to 200 ng/L total PFAS and a base-case untreated water concentration of 300 ng/L total PFAS (50 ng/L for each of the six PFAS compounds). The life-cycle GHG footprint for GAC (calculated using a commercially available green-and-sustainable remediation tool and published data) included production, transportation, and recycling, as well as a treatment vessel. The model incorporated residential and municipal-scale treatment scenarios. Input parameters were developed based on these scenarios, and used to calculate per-user CO_2 equivalent footprint (CEF) resulting from treatment of PFAS to drinking water target levels.

Results/Lessons Learned. The analysis focused on the State of Maine, but conclusions are broadly applicable due to concurrent PFAS and GHG initiatives across state and Federal agencies. As a benchmark for comparison, the U.S. per capita equivalent CO_2 footprint is 15 metric tons per year (MTY). Using the State of Maine's interim (at the time of writing) drinking treatment goal of 20 ng/L for the six PFAS combined, for municipal-scale treatment and coconut-based GAC (best case scenario) the CEF of an average user increased by 1.0 metric tons CO_2 equivalent, a 7% increase. In the worst-case scenario, involving private well water treatment and coal-based GAC, the CEF increased by 2.7 MTY (an 18% increase). Reducing the drinking water goal by an order of magnitude to 2 ng/L increased the CEF range from 5.4 to 17 MTY (i.e., a 36 to 113% CEF increase). A drinking water goal of 2 ng/L for combined PFAS challenges the best available detection limits, but is commensurate with the interim revised health advisory levels of 0.004 and 0.020 ng/L for PFOA and PFOS, respectively. Conversely, raising the target drinking water concentration to 200 ng/L increases the CEF by 0.1 to 0.47 MTY (<1 to 3%). The evaluation indicates that the CEF associated with PFAS treatment to low levels is substantial. As toxicology data are evaluated, and other societal costs are factored into development of treatment levels, the CEF should be included in these considerations. If toxicology data interpretations continue to drive drinking water target concentrations into the low-ppt (or sub-ppt) levels, achieving both PFAS and GHG reduction objectives would require more carbon-efficient treatment and/or GHG offsets to be found elsewhere.