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Emerging Thoughts: A Principled Framework for Regulating GenX as an Emerging Contaminant

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Emerging Thoughts: A Principled Framework for Regulating GenX as an Emerging Contaminant*

Local, state, and federal regulators are beginning to address "emerging contaminants"—previously unstudied chemicals detected in drinking water supplies that potentially may have severe environmental and human health consequences. In North Carolina, detection of the emerging contaminant GenX, the chemical produced when making nonstick coatings like Teflon, has raised serious questions. Is GenX safe? Should it be regulated and, if so, by whom? What values or rules should guide legislation when there is significant uncertainty over GenX's short- and long-term effects? While this Comment does not try to assess GenX's safety, it considers three theoretical frameworks for regulating GenX: the precautionary principle, cost-benefit analysis, and equity-based regulation. The goal is to highlight the difficulty in determining the path forward with potential regulations while balancing valid competing concerns. Ultimately, this Comment argues that the best way to regulate GenX draws from each of the three theoretical frameworks.

INTRODUCTION

Over the last few years, GenX has captivated many North Carolinians,[1] particularly those who rely on the Cape Fear River watershed[2] where the contaminant has been systematically dumped, possibly for decades.[3] GenX[4] is one of a number of "emerging contaminants" that scientists, state and local governments, and activists are just now beginning to investigate.[5]

Emerging contaminants are "generally defined as any contaminant on which scientific knowledge is insufficient";[6] they include man-made chemicals found in the water supply that may not have been previously detected.[7] Emerging is not synonymous with new[8]—many of these chemicals have been

1. Chrysta Carroll, *GenX Tops the News in 2017*, BLADEN J. (Dec. 29, 2017), https://www.bladenjournal.com/news/15846/genx-tops-the-news-in-2017 [https://perma.cc/9PTT-4YWL] ("Dominating local news and even receiving national attention is the ongoing controversy over GenX.").

2. Sheena Scruggs, *PFAS—a Problem in North Carolina Drinking Water*, NAT'L INST. ENVTL. HEALTH SCI. (Mar. 2019), https://factor.niehs.nih.gov/2019/3/feature/2-feature-pfas/index.htm [https://perma.cc/YRF3-QB9J] (noting that the Cape Fear River watershed provides water to 1.5 million North Carolinians); *see also GenX Frequently Asked Questions*, N.C. DEP'T ENVTL. QUALITY, https://files.nc.gov/ncdeq/GenX/SAB/FAQ_updated_021518.pdf [https://perma.cc/4PYZ-VBKX] (last updated Feb. 15, 2018) (highlighting that the river is the primary drinking source for Bladen, Brunswick, New Hanover, and Pender counties).

3. *See* Mick Kulikowski, *Finding GenX*, N.C. ST. UNIV. (Apr. 16, 2018), https://news.ncsu.edu/2018/04/finding-genx/ [https://perma.cc/AS7A-QL2Y] (detailing how researchers first found GenX in the watershed); *see also infra* notes 29–30 and accompanying text.

4. Technically, "GenX is a trade name for a technology that is used to make high performance fluoropolymers (e.g., some nonstick coatings) without the use of perfluorooctanoic acid (PFOA). Hexafluoropropylene oxide (HFPO) dimer acid and its ammonium salt are the major chemicals associated with the GenX technology." *Basic Information on PFAS*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/pfas/basic-information-pfas [https://perma.cc/5LNV-K5J5] (last updated Dec. 6, 2018). As used in this paper, GenX refers to the associated chemicals released by the technology, namely the HFPO dimer acid and ammonium salt.

5. *See* Kulikowski, *supra* note 3. ("[T]he first two papers about its occurrence in the environment were [only] published in 2015.").

6. Peter L. deFur, Laura E. Williams & Sarah D. Sanford, *Emerging Contaminants in Virginia*, 40 WM. & MARY ENVTL. L. & POL'Y REV. 519, 519–20 (2016).

7. *Contaminants of Emerging Concern*, WATER QUALITY ASS'N, https://www.wqa.org/whats-in-your-water/emerging-contaminants [https://perma.cc/VS4Z-323Y].

8. U.S. ENVTL. PROT. AGENCY, OW/ORD EMERGING CONTAMINANTS WORKGROUP, AQUATIC LIFE CRITERIA FOR CONTAMINANTS OF EMERGING CONCERN: PART I: GENERAL CHALLENGES AND RECOMMENDATIONS 2 (June 3, 2008) [hereinafter EMERGING CONTAMINANTS WORKGROUP], https://www.epa.gov/sites/production/files/2015-08/documents/white_paper_aquatic

used for the last half century, but researchers have only recently recognized their "ubiquitous presence" due to increased detection ability and awareness.[9] In fact, emerging contaminants are sometimes more aptly labeled contaminants of emerging concern;[10] now that we are aware of their pervasiveness, we understand the need for more scientific data and possible regulation.[11] Because these are previously unknown pollutants, contaminants of emerging concern are not regulated in the same manner as better-known contaminants, and the uncertainty of their impacts raises concerns for scientists, political officials, and local communities.[12]

GenX is an increasingly concerning contaminant because it likely causes adverse health effects but, without entirely clear and certain effects, regulators and communities are not sure how to respond. Local community members are hesitant to drink or use their water, manufacturers have struggled to reduce emissions, and state agencies and scientists are scrambling to understand GenX.[13] Ultimately, North Carolinians are left with a chemical in their water that "generally does not break down in the environment, cannot be removed by most water treatment techniques, can behave strangely in the human body, and [possesses] health risks [that] are not understood."[14]

_life_criteria_for_contaminants_of_emerging_concern_part_i_general_challenges_and_recommendations_1.pdf [https://perma.cc/8A33-H9NR] ("[These contaminants] are not necessarily new chemicals. They include pollutants that have often been present in the environment, but whose presence and significance are only now being evaluated.").

9. Jeff B. Kray & Sarah J. Wightman, *Contaminants of Emerging Concern: A New Frontier for Hazardous Waste and Drinking Water Regulation*, 32 NAT. RESOURCES & ENV'T 36, 36 (2018).

10. *See, e.g.*, *Contaminants of Emerging Concern Including Pharmaceuticals and Personal Care Products*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products [https://perma.cc/2QFB-8FF7] (last updated Aug. 19, 2019).

11. *See, e.g.*, Kray & Wightman, *supra* note 9, at 36; *Contaminants of Emerging Concern Including Pharmaceuticals and Personal Care Products*, *supra* note 10 (outlining methodological challenges for studying emerging contaminants and noting potential health concerns for aquatic life and possibly human life); *see also Contaminants of Emerging Concern*, *supra* note 7 ("Emerging contaminants are important because the risk they pose to human health and the environment is not yet fully understood.").

12. Kray & Wightman, *supra* note 9, at 36 ("This lack of scientific certainty is delaying regulatory action at the federal and state levels, where regulators are only beginning to address what the public increasingly believes is a major cause of concern."). For a history of emerging contaminants in the United States, see deFur et al., *supra* note 6, at 521–25.

13. *See, e.g.*, *Timeline: Tracking GenX Contamination in NC*, WRAL (Aug. 17, 2018), https://www.wral.com/timeline-tracking-the-route-of-genx-in-the-cape-fear-river/16869639/ [https://perma.cc/6LF4-6HZW] ("The Southern Environmental Law Center, on behalf of Cape Fear River Watch, file[d] suit in a New Hanover County court to force state regulators to immediately and completely shut down emissions of GenX from the Chemours . . . plant."). The state environmental agency repeatedly demanded that Chemours, the company that released GenX into the river, provide bottled water to residents. *Id.*

14. Trista Talton, *Biologist on GenX Health Effects: 'It's Toxic'*, COASTAL REV. ONLINE (Newport, N.C. Dec. 20, 2017), https://www.coastalreview.org/2017/12/biologist-on-genx-health-effects-its-toxic/ [https://perma.cc/2WEE-ZBXR].

This Comment focuses specifically on how to address GenX.[15] Contaminants of emerging concern are a diverse class of chemicals that have varying potential health and environmental risks.[16] With limited information known about most contaminants of emerging concern, it is impractical and unwise to draw broad-stroke conclusions about the full class. Thus, this Comment considers three major environmental frameworks to elucidate the challenges of and potential solutions to responding to GenX. Although this Comment is couched in GenX analysis, the ultimate goal is to spark broader conversations about how regulators and communities should address contaminants of emerging concern generally.

This Comment proceeds in three parts. Part I explains what GenX is and its relation to a broader set of contaminants known as per- and polyfluoralkyl substances ("PFAS"). Part II looks at three theoretical frameworks for addressing GenX. It starts with the precautionary principle, then considers cost-benefit analysis, and finishes with an equity-based approach. Within each subpart, it discusses the general premise and major criticisms of each framework, followed by application of the framework to GenX. Finally, Part III concludes by seeking to pull these three frameworks together into a few suggestions for regulating GenX.

I. UNDERSTANDING THE CURRENT SITUATION

A. *Molecularly Similar Chemicals Cause Trouble*

GenX is a contaminant that has made its way to the forefront of environmentalists' concerns because it is increasingly used as a substitute for other highly regulated or banned chemicals due to its similar structure and utility.

GenX falls under a broader category of man-made chemicals used in industry and consumer products worldwide known as per- and polyfluoroalkyl substances.[17] The EPA estimates that there are between 5000 and 10,000

15. GenX has been found in "surface water, groundwater, finished drinking water, rainwater, and air emissions in some areas," *Basic Information on PFAS*, *supra* note 4, but the initial focus has been primarily on the Cape Fear River. Thus, this Comment focuses on water contamination.

16. *See* deFur et al., *supra* note 6, at 520 ("[E]merging contaminants often fall into the following categories: pharmaceuticals, personal care products, endocrine disruptors, and industrial chemicals for which there may be no published health standards.").

17. U.S. ENVTL. PROT. AGENCY, PFAS WHAT YOU NEED TO KNOW [hereinafter INFOGRAPHIC] https://www.epa.gov/sites/production/files/2018-03/documents/pfasv15_2pg_0.pdf [https://perma.cc/H5X4-H6F3]; AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY DIV. OF COMTY. HEALTH INVESTIGATIONS, PERFLUOROALKYL AND POLYFLUOROALKYL SUBSTANCES (PFAS) FREQUENTLY ASKED QUESTIONS (Aug. 22, 2017) [hereinafter PFAS FAQS], https://files.nc.gov/ncdeq/GenX/pfas_fact_shee_atsdr-nceh_nopix.pdf [https://perma.cc/BE45-EZZF]. For information about general challenges with regulating PFAS as a broad class, see generally U.S. ENVTL. PROT. AGENCY, U.S. EPA PFAS RESEARCH AND DEVELOPMENT (2018),

PFAS,[18] found in everything from firefighting foams to water-resistant clothing to food packaging materials, and even to some cosmetics.[19] Companies widely use them because they have several advantageous chemical properties. For example, PFAS are generally resistant to heat, water, and oil, which makes them desirable for commercial products like Teflon or rain-repellent clothing.[20] However, those same properties can make PFAS environmentally troublesome because PFAS resist degradation and endure in the environment.[21] And because of their diversity of characteristics, PFAS may be regulated under a few different environmental laws,[22] or not at all. Therein lies the problem: industry and consumers pollute drinking water systems with chemicals that have not been proven safe for consumption. We often begin regulating these chemicals only *after* we learn of their harmful effects.

For example, two of the most extensively produced and studied PFAS, perfluorooctanoic acid ("PFOA") and perfluorooctanesulfonic acid ("PFOS"), have now been phased out because of troubling environmental and health consequences.[23] High concentrations of PFOA and PFOS have caused tumors,

https://www.epa.gov/sites/production/files/2018-08/documents/r4_combined_presentations_.pdf [https://perma.cc/38YT-C5RM] (reproducing PowerPoint slides used in a Fayetteville community engagement meeting).

18. LAURENCE LIBELO, U.S. ENVTL. PROT. AGENCY, OFFICE OF LAND AND EMERGENCY MANAGEMENT: PFAS ACTIVITIES UPDATE (2018), https://www.epa.gov/sites/production/files/2018-08/documents/r4_combined_presentations_.pdf [https://perma.cc/38YT-C5RM]; *see also* Lisa Sorg, *EPA Officials Get an Earful at GenX Hearing in Fayetteville*, N.C. POL'Y WATCH (Aug. 15, 2018), http://www.ncpolicywatch.com/2018/08/15/epa-officials-get-an-earful-at-genx-hearing-in-fayetteville/ [https://perma.cc/N98D-EEGK] ("Tens of thousands of fluorinated compounds exist, but only about 4,700 have names, and of those, the science is still lacking.").

19. INFOGRAPHIC, *supra* note 17; PFAS FAQS, *supra* note 17.

20. *See* INFOGRAPHIC, *supra* note 17; PFAS FAQS, *supra* note 17.

21. *See* Sharon Lerner, *A Chemical Shell Game: How DuPont Concealed the Dangers of the New Teflon Toxin*, INTERCEPT (Mar. 3, 2016, 3:51 PM), https://theintercept.com/2016/03/03/how-dupont-concealed-the-dangers-of-the-new-teflon-toxin/ [https://perma.cc/3EMS-DWFM] [hereinafter Lerner, *A Chemical Shell Game*] ("Perfluorooctanoic acid, commonly known as PFOA or C8, is a 'perfluorinated' chemical, which means that its base includes carbon chains attached to fluorine atoms. Because the fluorine-carbon bond is one of the strongest in chemistry, these compounds are incredibly stable, which makes them useful in industry. But that stability also makes them endure in the environment. Indeed, C8 . . . is expected to remain on the earth long after humans are extinct.").

22. Sharon Lerner, *EPA Continues To Approve Toxic PFAS Chemicals Despite Widespread Contamination*, INTERCEPT (Oct. 25, 2018, 12:35 PM), https://theintercept.com/2018/10/25/epa-pfoa-pfas-pfos-chemicals/ [https://perma.cc/7TQD-F86J] (noting that about 1200 PFAS are regulated under the Toxic Substances Control Act ("TSCA") Chemical Substance Inventory); *see* U.S. ENVTL. PROT. AGENCY, EPA'S PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) ACTION PLAN 2 n.1 (2019) [hereinafter ACTION PLAN] (noting that there may be a way to regulate certain PFAS as "hazardous substance[s]" under a variety of statutory mechanisms). Other PFAS may be regulated as food, pesticides, drugs, or cosmetics. *See About the TSCA Chemical Substance Inventory*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/tsca-inventory/about-tsca-chemical-substance-inventory#whatdoesitmean [https://perma.cc/7YGC-5V46] (last updated Sept. 24, 2019).

23. INFOGRAPHIC, *supra* note 17 ("U.S. manufacturers voluntarily phased out PFOA and PFOS, two specific PFAS chemicals."); *see also Fact Sheet: 2010/2015 PFOA Stewardship Program*, U.S. ENVTL.

reproductive and developmental defects, immunological effects, and liver and kidney problems in laboratory animals.[24]

B. *GenX: The New Kid on the Block*

As regulators and industry focused more attention on reducing PFOA and PFOS in the United States (mostly successfully)[25] companies sought out alternative chemicals that could provide useful chemical properties and avoid strict regulation[26]—at least temporarily. To continue making polymers such as Teflon and food-wrapper coatings,[27] the Chemours Company ("Chemours")[28]

PROTECTION AGENCY, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program [https://perma.cc/A599-23WZ] (last updated Aug. 9, 2018) (detailing the EPA's global stewardship program to phase out PFOA use in U.S. operations). The EPA has also issued a series of health advisories for PFOA and PFOS, U.S. ENVTL. PROT. AGENCY, EPA 800-F-16-003, FACT SHEET: PFOA & PFOS DRINKING WATER HEALTH ADVISORIES 1 (Nov. 2016), https://www.epa.gov/sites/production/files/2016-06/documents/drinkingwaterhealthadvisories_pfoa_pfos_updated_5.31.16.pdf [https://perma.cc/DZP5-VT3B], and announced a new PFAS action plan in part to address PFOA and PFOS. *See generally* ACTION PLAN, *supra* note 22 (outlining the plan and specific measures for PFOA and PFOS).

24. INFOGRAPHIC, *supra* note 17. For more details on the laboratory animal models, see *Perfluourinated Chemical: Toxicity Research with Animal Models*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas [https://perma.cc/U7M4-6AVY] (last updated Nov. 26, 2019).

25. *Fact Sheet: 2010/2015 PFOA Stewardship Program*, *supra* note 23 (noting that the eight multinational companies in the EPA's global stewardship program no longer are manufacturing PFOA in the U.S., but that there may still be existing stocks of PFOA or PFOA in imported articles). *But see* Kulikowski, *supra* note 3 (finding PFOA and PFOS in the Cape Fear River in 2013). Furthermore, during the PFAS National Leadership Summit in May 2018, the EPA highlighted steps to continue regulating PFOA and PFOS through CERCLA and Maximum Contaminant Levels. *See* Press Release from Alexandra Dunn, Reg'l Adm'r, U.S. Envtl. Prot. Agency, New England Region, EPA Seeks Public Input for National Plan To Manage PFAS at First Community Engagement Event (June 19, 2018), https://www.epa.gov/newsreleases/epa-seeks-public-input-national-plan-manage-pfas-first-community-engagement-event [https://perma.cc/FB8C-XLS4].

26. *Fact Sheet: 2010/2015 PFOA Stewardship Program*, *supra* note 23 ("[M]ost companies [in the stewardship program] stopped manufacture and import of long-chain PFAS[], and then transitioned to alternative chemicals.").

27. Kulikowski, *supra* note 3; *see supra* note 21 and accompanying text.

28. Chemours is a spinoff of DuPont. Jack Kaskey, *DuPont To Split with Spin Off of Performance Chemicals*, BLOOMBERG (Oct. 25, 2013, 4:25 PM), https://www.bloomberg.com/news/articles/2013-10-24/dupont-to-spin-off-performance-chemicals-unit-to-shareholders [https://perma.cc/Y4FV-3RP3 (dark archive)]; *see also* Jef Feeley & Tiffany Kary, *Chemours Sues DowDupont Over Spinoff To Assume Liabilities*, BLOOMBERG (May 14, 2019, 11:02 AM), https://news.bloombergenvironment.com/environment-and-energy/chemours-sues-dowdupont-over-spinoff-to-assume-liabilities [https://perma.cc/7TE4-C5UX (dark archive)] (noting that Chemours is seeking to make DuPont assume liabilities from their spinoff transaction).

relied more heavily on GenX,[29] a chemical compound molecularly similar to PFOA.[30]

Because GenX is structurally similar to its PFOA predecessor, a known carcinogen,[31] there are concerns that GenX may also have detrimental environmental and human health effects.[32] Early studies on laboratory animals have indicated that exposure to GenX can have negative effects on the blood and liver in addition to causing pancreatic, testicular, and liver cancer.[33] Rats exposed to GenX in a 2013 study developed cancerous and benign tumors, kidney disease, and uterine polyps.[34]

29. Chemours has used GenX since the 1980s, but in 2009 the company began using the chemical more frequently as a PFOA replacement in response to litigation regarding, and mounting evidence of, PFOA's potential adverse health effects. INFOGRAPHIC, *supra* note 17; Kulikowski, *supra* note 3; Adam Wagner & Tim Buckland, *Chemours: GenX Polluting the Cape Fear Since 1980*, STARNEWS ONLINE (Wilmington, N.C. June 16, 2017, 12:06 AM), https://www.starnewsonline.com/news/20170615/chemours-genx-polluting-cape-fear-since-1980 [https://perma.cc/P52Y-8BVF]. Given the lack of regulation, it is unclear when GenX was first used, although there was likely greater use of GenX at the Fayetteville factory starting in 2009. *See, e.g.*, Emery P. Dalesio, *EPA Hits Chemical Maker for Not Notifying on New Compounds*, ASSOCIATED PRESS (Feb. 15, 2019), https://www.apnews.com/11ab5a446a584202b0fb0dd5ebb6b626 [https://perma.cc/S472-3YQQ] (noting that, in February 2019, the EPA cited Chemours for "fail[ing] to give those required notices for several chemicals including [GenX]"); Wagner & Buckland, *supra*. Chemical companies can claim that part of the information that they are reporting about new chemicals is confidential business information, essentially sanitizing documents and limiting public access. Lerner, *A Chemical Shell Game*, *supra* note 21 ("About 95 percent of new chemical notifications, according to a 2005 Government Accountability Office report, include information that is protected as a trade secret, a figure the EPA confirmed as still 'generally accurate.'"). This also makes it harder to determine when and how much GenX Chemours has produced.

30. INFOGRAPHIC, *supra* note 17; *see also* Lerner, *A Chemical Shell Game*, *supra* note 21 ("And evidence suggests that many of [PFOA's] replacements are just as persistent.").

31. Lerner, *A Chemical Shell Game*, *supra* note 21 (finding that replacement chemicals for PFOA "likely had 'the same chemical performance properties' as the older generation of" PFOS, like PFOA, which suggests "'that their toxicity and environmental persistence are likely to be similar as well'" (internal citation omitted)). For some of the environmental impacts of PFOA, including environmental persistence, widespread distribution in surface waters, long-range transport and discovery in remote regions like the Arctic, and bioaccumulation in food webs, see generally Lena Vierke et. al, *Perfluorooctanoic acid (PFOA)—Main Concerns and Regulatory Developments in Europe from an Environmental Point of View*, 24 ENVTL. SCI. EUR. 16 (2012) (summarizing the environmental concerns of PFOA).

32. *See* Vince Winkel, *GenX: A Question of Chemistry*, WHQR (June 20, 2017), https://www.whqr.org/post/genx-question-chemistry#stream/0 [https://perma.cc/X2QR-WRAS] ("So this is very parallel to what we knew about PFOA, C8, in the 1990s, and my concern is that if these new GenX compounds if they have properties, I would be concerned that there might be additional toxic effects."); *see also* N.C. DEP'T OF HEALTH & HUMAN SERVS., GENX HEALTH INFORMATION 1 (2017), https://files.nc.gov/ncdeq/GenX/GenX%20factsheet%20FINAL%2013Sep2017.pdf [https://perma.cc/Z96J-55ZA] (explaining the harmful effects of GenX found in tests on lab animals).

33. N.C. DEP'T OF HEALTH & HUMAN SERVS., *supra* note 32.

34. Sharon Lerner, *New Teflon Toxin Causes Cancer in Lab Animals*, INTERCEPT (Mar. 3, 2016, 3:49PM), https://theintercept.com/2016/03/03/new-teflon-toxin-causes-cancer-in-lab-animals/ [https://perma.cc/PRB9-KDEE] [hereinafter Lerner, *New Teflon Toxin*]. Contaminant toxicology

In fact, looking to PFOA to understand GenX is not a novel concept.[35] Because there were no standards for GenX when researchers first found it in the Cape Fear River, they looked to similar compounds, concluding that the "631 parts per trillion [of GenX] found was a high concentration relative to EPA's 70 parts per trillion health advisory level for PFOS and PFOA."[36] Thus, from the start there were concerns about the potential health consequences of GenX, in part because of its similarity to dangerous chemicals that were better understood.[37]

Manufacturing interests are partly responsible for the uncertainty over the impact of GenX on environmental and human health; chemical companies can claim that part of the information they are reporting about new chemicals is confidential business information protected by trade secret laws.[38] For example, it appears that the EPA may have flagged concerns about GenX in a 2009 consent order that highlighted serious concerns with a PFOA-replacement chemical.[39] The EPA raised issues about toxicity and bioaccumulation, long-term environmental effects, and human health concerns but "sanitized" the order by removing the name of the chemical prior to making the order public.[40] This redacted chemical is believed to be GenX, a plausible conclusion given the

studies performed on animals are not always indicative of potential human consequences for a number of reasons. *See* J.M. Caverly Rae et al., *Evaluation of Chronic Toxicity and Carcinogenicity of Ammonium 2,3,3,3-Tetrafluoro-2-(Heptafluoropropoxy)-Propanoate in Sprague–Dawley Rats*, 2 TOXICOLOGY REP. 939, 939–40, 948 (2015) ("[T]he finding of benign tumors [in this study] . . . is of questionable human relevance."). *But see* Lerner, *New Teflon Toxin*, *supra* (criticizing the study as "cherry picking" results and noting the similarities in the results of animal testing between GenX and PFOA).

35. *See* Winkel, *supra* note 32 (noting that a toxicologist, in the face of limited information, says to understand GenX, one needs to look to PFOA: "And so the only way to have an idea of what could be expected from exposure to a chemical like that is to look at what is known about a similar chemical, and there has been a lot of talk about how GenX was the replacement for . . . PFOA").

36. Kulikowski, *supra* note 3.

37. *See* Winkel, *supra* note 32 ("So this is very parallel to what we knew about PFOA, C8, in the 1990s, and my concern is that if these new GenX compounds if they have properties, I would be concerned that there might be additional toxic effects."); *see also Occupational & Environmental Epidemiology*, N.C. DEP'T HEALTH & HUM. SERVS., https://epi.dph.ncdhhs.gov/oee/a_z/genx.html [https://perma.cc/2E8Z-R9ML] (explaining the harmful effects of GenX found in tests on lab animals).

38. Lerner, *A Chemical Shell Game*, *supra* note 21 ("About 95 percent of new chemical notifications, according to a 2005 Government Accountability Office report, include information that is protected as a trade secret, a figure the EPA confirmed as still 'generally accurate.'").

39. *Id.* (tracking the story); *see also* Consent Order and Determinations Supporting Consent Order at vii–x, DuPont Co. Premanufacture Notice Nos. P-08-508 and P-08-50 (U.S. Envtl. Prot. Agency, Jan. 28, 2009), https://www.documentcloud.org/documents/2746607-Sanitized-Consent-Order-P08-0508-and-P08-0509.html [https://perma.cc/9V77-WPSA].

40. Lerner, *A Chemical Shell Game*, *supra* note 21. ("The document also lays out concerns that the molecules 'will persist in the environment, could bioaccumulate, and be toxic ("PBT") to people, wild mammals, and birds'; that 'there is high concern for possible environmental effects over the long-term'; and that 'EPA has human health concerns for the [pre-manufactured notice] substances.'").

time period.[41] The order itself highlights three important takeaways. First, although the science around GenX is not completely certain, local scientists and the EPA have spoken out against GenX or at least expressed concern over the chemical's potential negative consequences.[42] Second, industry may be undermining potential environmental and health protections because it can protect relevant research about environmental and human health effects as confidential business information.[43] And third, even the EPA thinks it is okay to analogize between structurally similar chemicals, drawing conclusions in its consent order about the redacted replacement chemical based on PFOA and PFOS in the same way scientists are drawing conclusions about GenX from its "structurally similar . . . chemical [composition] and data on the . . . substance[] [itself]."[44]

C. *Response to GenX*

Before proceeding, it is important to highlight a few key players. At the federal level, the EPA issues environmental regulations. The state parallel in North Carolina is the Department of Environmental Quality ("DEQ").[45] The EPA may issue specific authority to state agencies like DEQ to carry out particular air or water permit programs.[46] Following a publication in Wilmington's *Star-News* in 2017 detailing the initial discovery of GenX in the Cape Fear River, response to potential GenX contamination has developed rapidly but with mixed results. The State has taken short-term measures, like requiring Chemours to issue bottled water to residents, and the federal government is looking at developing longer-term plans.[47] Yet, as North Carolina and the federal government seek more permanent solutions, progress has been stalled by spills and non-compliance by Chemours.

41. *Id.*

42. *See* Amena H. Saiyid & Sylvia Carignan, *Toxicity Study of Chemours' GenX Expected by Year's End, EPA Says*, BLOOMBERG ENV'T (Apr. 3, 2019, 5:43 PM), https://news.bloombergenvironment.com/environment-and-energy/toxicity-study-of-chemours-genx-expected-by-years-end-epa-says [https://perma.cc/SS7J-RV9L (dark archive)] (planning to conduct an assessment of the toxicity of GenX by the end of 2019).

43. Lerner, *A Chemical Shell Game*, *supra* note 21. Interestingly, the order suggests that the EPA is also aware of this knowledge, even if it does not make it public.

44. Consent Order and Determinations Supporting Consent Order at vii, DuPont Co. Premanufacture Notice Nos. P-08-508 and P-08-50 (U.S. Envtl. Prot. Agency Jan. 28, 2009), https://www.documentcloud.org/documents/2746607-Sanitized-Consent-Order-P08-0508-and-P08-0509.html [https://perma.cc/9V77-WPSA].

45. Specifically, DEQ was created to administer the state's "regulatory programs designed to protect air quality, water quality, and the public's health." *See What We Do*, NC DEP'T ENVTL. QUALITY, https://deq.nc.gov/ [https://perma.cc/SE8L-WQYM]. For general information on the structure of environmental regulations in North Carolina, see MARIA SAVASTA-KENNEDY, LEXISNEXIS PRACTICE GUIDE: NORTH CAROLINA ENVIRONMENTAL LAW §§ 1.04–.09.

46. *Id.* § 1.09.

47. *Timeline: Tracking GenX Contamination in NC*, *supra* note 13.

In September 2017, DEQ ordered Chemours to stop releasing all fluorinated compounds, including GenX, into the Cape Fear River and began enforcement actions against the company.[48] The North Carolina Department of Health and Human Services ("NCDHHS") also released a preliminary health assessment of GenX, setting a state health goal of 140 parts per trillion.[49] DEQ and Chemours sampled nearby residential wells surrounding the Fayetteville facility starting in September 2017.[50] Preliminary groundwater testing failed the state health goal for at least thirty-five residential well owners; in response, DEQ directed Chemours to provide bottled water.[51] Although DEQ considered suspending Chemours's wastewater discharge permit in September, in response to Chemours agreeing to capture additional PFAS and comply with other conditions, DEQ decided against suspension but would instead continue monitoring water quality.[52] As a result, by the end of October 2017, concentrations of GenX in the Cape Fear River had "dropped to below the state's provisional health goal at all finished drinking water sites."[53] However, in October, the Cape Fear Public Utility Authority sent a letter of intent to file for violations of the Clean Water Act alleging that Chemours's wastewater discharge permit did not authorize GenX discharge and that Chemours knowingly contaminated the Cape Fear River.[54]

In November 2017, due to an unreported spill, DEQ partially revoked Chemours's wastewater permit following increases in GenX and other contaminants.[55] DEQ also issued a notice of violation because a smoke stack

48. Partial Consent Order at 2, North Carolina v. Chemours Co., No. 17 CVS 580 (Sept. 8, 2017), https://files.nc.gov/ncdeq/GenX/Partial%20Consent%20Order.pdf [https://perma.cc/943L-BHEP].

49. *Timeline*: *Tracking GenX Contamination in NC*, *supra* note 13.

50. *Id.*

51. Press Release, N.C. Dep't of Envtl. Quality, State Directs Chemours To Provide Bottled Water to Nine More Well Owners After Latest Preliminary Tests for GenX (Oct. 17, 2017), https://deq.nc.gov/news/press-releases/2017/10/17/state-directs-chemours-provide-bottled-water-nine-more-well-owners [https://perma.cc/2PW9-3CMU]. That number has risen to at least 690 private drinking water wells within a 5.5-mile radius of Chemours's facility. *SELC, Riverkeeper File To Immediately Stop GenX Pollution in N.C.*, S. ENVTL. L. CTR. (May 7, 2018), https://www.southernenvironment.org/news-and-press/news-feed/selc-riverkeeper-file-to-immediately-stop-genx-pollution-in-n.c [https://perma.cc/68QL-9527].

52. Letter from Linda Culpepper, Deputy Dir., Div. of Water Res. to Ellis H. McGaughy, Plant Manager, Chemours Co., (Oct. 24, 2017), https://files.nc.gov/ncdeq/documents/files/2017%2010%2024%20Ltr%20to%20Ellis%20McGaughy%20Chemours%20re%20NPDES%20permit.pdf?7.webAb0nLemriVy0Nx3qqTJYnXQ4Nmc [https://perma.cc/TS29-CNDY].

53. Press Release, N.C. Dep't of Envtl. Quality, DEQ Takes Action To Stop Additional Chemours Discharge Based on EPA Report (Oct. 30, 2017), https://deq.nc.gov/news/press-releases/2017/10/30/deq-takes-action-stop-additional-chemours-discharge-based-epa-report [https://perma.cc/U3H3-B6PQ].

54. Complaint at 19–20, Cape Fear Pub. Util. Auth. v. Chemours Co. (E.D.N.C. 2017).

55. Letter from Linda Culpepper, Interim Dir., Div. of Water Res., to Ellis H. McGaughy, Plant Manager, Chemours Co. (Nov. 16, 2017), https://files.nc.gov/ncdeq/GenX/Letter%20November%2011-16-17.pdf [https://perma.cc/AX55-WUBR] ("Because of the misrepresentations and inadequate disclosures by Chemours . . . , [DEQ] is suspending the Permit provisions that authorize

"deposited [GenX] onto the ground surface."[56] At the same time, DEQ required Chemours to implement a new air abatement system, which would include disposing of waste material offsite.[57] Chemours ultimately became responsible for developing a test protocol as well as for air sampling. Within a few months, Chemours was facing additional violations, once more for groundwater contamination.[58]

Against the backdrop of increasing measures to rein in Chemours, the State still lacked sufficient scientific data on GenX and thus sought to better understand the contaminant.[59] The governor expanded the Secretary's Science Advisory Board in order to guide state officials on how to protect public health and the environment from new or unregulated chemicals.[60] North Carolina's 2018 appropriations bill allocated funds to the local utility to analyze impacts of GenX and similar compounds at the site of contamination, earmarked money for grants to study technologies to monitor these compounds, funded relief for contaminated drinking water, and granted the governor power to close non-compliant facilities.[61]

Yet for all the steps that have been taken, GenX is hardly under control. Regulators need to step back and chart out a course to approach GenX regulation in a systematic and deliberate way. This Comment offers suggestions

Chemours to discharge process wastewater from the Chemours Fluoromonomers/Nafion Membrane manufacturing area.").

56. Letter from J. Trent Allen, Reg'l Supervisor, N.C. Dep't of Envtl. Quality, to Mark P. Vergnano, Chemours Co. (Nov. 13, 2017), https://files.nc.gov/ncdeq/GenX/Chemours%20DWR-NOV%20111317.pdf [https://perma.cc/879D-NMLC].

57. *See State Orders Chemours To Control Additional Sources of GenX Contamination*, N.C. DEP'T ENVTL. QUALITY (Feb. 13, 2018), https://deq.nc.gov/news/press-releases/2018/02/13/state-orders-chemours-control-additional-sources-genx-contamination [https://perma.cc/W4EB-6K74].

58. Letter from Michael E. Scott, Dir., Div. of Waste Mgmt., to Ellis H. McGaughy, Plant Manager, Chemours Co. (Feb. 12, 2018), https://files.nc.gov/ncdeq/GenX/Chemours%20NOV%20Signed%20_021218.pdf [https://perma.cc/MY66-QBUZ].

59. *See* Press Release, N.C. Dep't of Envtl. Quality, DEQ Secretary Regan Cites Lab Equipment as Critical to Emerging Contaminants Response (Jan. 11, 2018), https://deq.nc.gov/news/press-releases/2018/01/11/deq-secretary-regan-cites-lab-equipment-critical-emerging [https://perma.cc/SK7B-MDXL].

60. *Secretaries' Science Advisory Board*, N.C. DEP'T ENVTL. QUALITY, https://deq.nc.gov/about/boards-and-commissions/secretaries-science-advisory-board [https://perma.cc/DGD8-4YM9].

61. Current Operations Appropriations Act of 2018, ch. 143, § 13.1(a)–(o), 2018 N.C. Sess. Laws 127, 127–32 (codified at N.C. GEN. STAT. §§ 143-215.2A to 143-215.3E). For political issues over funding GenX research, see generally Matthew Burns & Laura Leslie, *Lawmakers Override Veto of GenX Study Money, Bag Ban Repeal*, WRAL (Oct. 4, 2017), https://www.wral.com/lawmakers-override-veto-of-genx-study-money-bag-ban-repeal/16993453/ [https://perma.cc/NW4U-DW5R] (overriding the governor's veto that sought more money to fund not just the public utility authority but also DEQ and DHHS); *see also* Travis Fain, *Industry Gets Requested Changes on GenX Bill*, WRAL (May 31, 2018), https://www.wral.com/industry-gets-requested-changes-on-genx-bill/17594159/ [https://perma.cc/7PV7-XUZV]; *The Legislative Response to GenX*, SMITHENVIRONMENT BLOG (Sept. 10, 2017), http://www.smithenvironment.com/the-legislative-response-to-genx/ [https://perma.cc/55H7-JVKZ].

for how to do so through the lens of three theoretical frameworks for environmental decisionmaking.

II. THEORETICAL FRAMEWORKS TO APPROACH ENVIRONMENTAL REGULATION

Approaches to environmental regulation can diverge dramatically as stakeholders try to decide what goals to achieve and the best means to achieve them. Theoretical frameworks are valuable at this juncture because they provide guidelines for allocating limited resources to tackle and mitigate risk. "We need some way to reasonably, consistently, and with limited information, prioritize certain risks over others and choose among available policy instruments."[62] The best approach borrows from multiple frameworks, which is intuitively palatable. Any single theoretical framework is overly reductive, whereas a combined approach is inherently more nuanced and adaptable. Environmental regulations often employ multiple policy instruments. For example, the Clean Water Act uses a number of these instruments—prescriptive regulation, payments, and persuasion—in order to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[63] Attacking a complex problem from multiple angles allows for greater success.[64] While wanting to combine different frameworks is not groundbreaking,[65] it is an important first step in ensuring informed decisionmaking.

Accordingly, three broad frameworks provide the foundation for possible regulatory solutions: the precautionary principle, cost-benefit analysis, and equity-based considerations.[66] Each of these three frameworks analyzes risk,

62. John Wood, *Can We Teach Old Laws a New Risk? Federal Environmental Law, Risk Management Theory, and Contamination of U.S. Water Supplies with Pharmaceutical and Personal Care Products*, 21 N.Y.U. ENVTL. L.J. 193, 210 (2014).

63. 33 U.S.C. § 1251(a) (2018); *see id.* § 1311(a) (prescriptive); *id.* § 1329(h)–(i) (payments and persuasion); *see also* James Salzman, *Teaching Policy Instrument Choice in Environmental Law: The Five P's*, 23 DUKE ENVTL. L. & POL. F. 363, 364–66, 372–74 (2013).

64. *See* THE JOHNSON FOUND. AT WINGSPREAD, CONFERENCE REPORT: CONSIDERING THE CLEAN WATER ACT 5 (Oct. 26–28, 2009), https://www.johnsonfdn.org/sites/default/files/Clean_Water_Act_3.02.10.web_.pdf [https://perma.cc/JJ9R-6E6V] (critiquing the Clean Water Act for focusing too much on prescriptive regulations).

65. *See* Wood, *supra* note 62, at 198 (combining multiple angles to address pharmaceutical and personal care products).

66. Special recognition goes to Professor Sheldon "Shelley" Holliday Welton for providing the suggestion to consider an equity-based framework. This Comment addresses only three of many frameworks. *See id.* at 210 (presenting at least 10 frameworks). I decided these frameworks were sufficiently distinct ways to view risk. I rejected some frameworks because I thought they would not provide insight into regulating GenX. For example, "[a]lthough Congress has written the no-risk framework into legislation, it is a straw man unworthy of serious consideration." LESTER B. LAVE, THE STRATEGY OF SOCIAL REGULATION: DECISION FRAMEWORKS FOR POLICY 13 (Brookings Inst. 1981).

including those of potential and possibly unknown harm, economic destruction, and unfair distribution of environmental consequences.[67]

"At its simplest, risk-based regulation can be conceived as allocating resources in proportion to risks to society[,] . . . considering both the impacts themselves and the likelihood that they happen, in order to establish appropriate levels of control."[68] Risk-based decisionmaking

> provides one way of managing institutional risks by explicitly anticipating those risks within probabilistic calculations of regulatory success and failure. Conceived in this way, risk-based regulation is about defining the limits of what regulation can be expected to achieve. Risk is therefore an attractive concept for regulators because it provides a powerful rationale for regulatory activity and behaviours.[69]

Thus, this discussion of theoretical frameworks is couched in the concept of risk because it is easily rationalized and can also be intuitive to understand. For example, individuals make decisions daily by evaluating, at least in part, risk for both themselves and the planet, such as when deciding whether to wear a seatbelt in the car or whether to recycle plastic water bottles. To approach GenX, regulators must actively consider risk assessment and management.

There is already some federal legislation that applies to GenX.[70] However, this legislation has been ineffective in protecting communities surrounding the Cape Fear River. Although an existing federal environmental law may be key to sufficiently addressing GenX, the purpose of this Comment is to explore the underlying principles that should be considered when regulating the chemical.

67. *But see* LAVE, *supra* note 66, at 8–28 (listing multiple frameworks considering risk but also non-risk-based frameworks like regulatory budget). I argue that all approaches consider risk, either explicitly or implicitly. For example, in the regulatory budget framework, agencies may be given "an implementation budget in the form of a limit on the total annual costs that its regulations could impose." *Id.* at 21. How an agency decides to impose regulations may be an implementation of cost-effectiveness analysis, but that relies on an evaluation of risk: Do we think that chemical Y is so dangerous that we are willing to prioritize its elimination over several other chemicals that would be cheaper to eliminate? *But see* John S. Applegate, *The Taming of the Precautionary Principle*, 27 WM. & MARY ENVTL. L. & POL'Y REV. 13, 36 (2002) (pointing out that some proponents of the precautionary principle view it as hazard based not risk based).

68. Henry Rothstein et. al, *The Risks of Risk-Based Regulation: Insights from the Environmental Policy Domain*, 32 ENVTL. INT'L 1056, 1057 (2006).

69. *Id.* (citation omitted).

70. Notably, Chemours's wastewater discharge permit is regulated under the Clean Water Act. Under the Safe Drinking Water Act, the EPA adopts national drinking water standards for contaminants. GenX is *not* currently one of them although the State has established its own advisory health goal. *The Laws in the Background of the GenX Issue*, SMITHENVIRONMENT BLOG (Aug. 21, 2017), http://www.smithenvironment.com/the-laws-in-the-background-of-the-genx-issue/ [https://perma.cc/MN5M-W5ZD].

A. *Precautionary Principle*

1. The Framework Generally

The precautionary principle "aims to prevent harm before a hazard has come into existence";[71] under this principle, polluters should have to prove something is safe rather than prove that it is dangerous. As the EPA has explained the principle, "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context, the proponent of an activity, rather than the public, should bear the burden of proof."[72]

Although the United States and other countries incorporated precautionary thinking into some environmental policies at their genesis, it was Germany in the 1970s that developed the precautionary principle into a broader environmental philosophy.[73] Today, the European Union is regarded as being more precautionary than the United States—many European Union environmental statutes specifically adopt a precautionary principle[74]—but the United States has not completely abandoned the precautionary approach.[75] In fact, a revival of precautionary thinking is important for regulating GenX.

2. Application to GenX

An approach guided by the precautionary principle would prohibit the technologies that produce GenX chemicals unless GenX is proven to be safe. At first glance, the Toxic Substances Control Act ("TSCA") serves as a prime application of the precautionary principle in action.[76]

Although detractors "have consistently criticized the [p]rinciple . . . as paralyzing, inflexible, and extreme,"[77] it gained traction in the Frank R.

71. *The Precautionary Principle in the European Environmental, Health and Food Safety Policy*, ECOLOGIC INST., https://www.ecologic.eu/1126 [https://perma.cc/DG37-67AV].

72. U.S. ENVT'L. PROT. AGENCY, RECORDS OF DECISIONS, EPA-ID 4890008952 (2008).

73. Andrew Jordan & Timothy O'Riordan, *The Precautionary Principle: A Legal and Policy History*, *in* THE PRECAUTIONARY PRINCIPLE: PROTECTING PUBLIC HEALTH, THE ENVIRONMENT AND THE FUTURE OF OUR CHILDREN 31, 33 (Marco Martuzzi & Joel A. Tickner eds., 2004).

74. *Id.* at 40. *See generally* Peter Breyer, *The Future Directive on Environmental Liability—A Tool To Implement the Precautionary Principle?*, ECOLOGIC INST., https://www.ecologic.eu/sites/files/publication/2017/929_backgroundpaper.pdf [https://perma.cc/N8W8-Y898] (analyzing the precautionary principle in European law).

75. *See generally* Sheldon Krimsky, *The Unsteady State and Inertia of Chemical Regulation Under the US Toxic Substances Control Act*, 12 PLOS BIOLOGY, e200240 1–5 (2017) (considering the factors that have worked against a comprehensive policy for regulating toxic chemicals, and discussing whether the TSCA revisions offer greater public protection against existing new chemicals).

76. *See* 15 U.S.C. § 2601 (2018).

77. Noah M. Sachs, *Rescuing the Strong Precautionary Principle from Its Critics*, 2011 U. ILL. L. REV. 1285, 1285.

Lautenberg Chemical Safety for the Twenty-First Century Act.[78] The Act amended the TSCA in several ways, but most notably it requires pre-market review of new chemicals.[79] The EPA Administrator is now required to make an affirmative finding on the safety of a new chemical (or significant new use of an existing chemical) before it is allowed into the marketplace.[80] Specifically, pre-manufacture notice must be filed with the EPA, which then reviews the notice and determines the human health and environmental risks of the chemical.[81] The EPA then issues an order outlining necessary measures like "prohibit[ing] or limit[ing] any combination of . . . activities to the extent necessary to protect against an unreasonable risk of injury to health or the environment."[82] Ultimately, a company cannot manufacture or import "a new chemical substance" unless the EPA has reviewed it.[83] "The review process exists to make sure that new chemicals are safe and that new uses those chemicals are put to are also safe . . . . It's a basic requirement that's intended to protect health and safety."[84]

However, as the adage goes, easier said than done. In May 2018, the Cape Fear River Watch[85] filed notice of intent to sue Chemours for a violation of the TSCA's new chemical substance provision.[86] The EPA issued a consent order for the main GenX chemicals under the Pre-Manufacture Notice process.[87] Given the uncertainties regarding GenX and the potential for the chemical to be used in substantial quantities and to be highly persistent in the environment, the consent order required DuPont, and subsequently Chemours, to "recover and capture (destroy) or recycle the [pre-manufacture notice] substances at an overall efficiency of 99% from all the effluent process streams and the air emissions (point source and fugitive)."[88] The Cape Fear River Watch is suing

78. *But see* Sarah E. Light, Opinion, *New Toxic Chemical Legislation Fails on Federalism*, REG. REV. (June 9, 2016), https://www.theregreview.org/2016/06/09/light-new-chemical-legislation-fails/ [https://perma.cc/JV9U-GH66] (arguing that the amendment fails precautionary federalism).

79. *Highlights of Key Provisions in the Frank R. Lautenberg Chemical Safety for the 21st Century Act*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/highlights-key-provisions-frank-r-lautenberg-chemical [https://perma.cc/7HUR-4E5L] (last updated June 23, 2016).

80. *Id.*

81. 15 U.S.C. § 2604(a)(1)(B) (2018).

82. *Id.* § 2604(e)(1)(A).

83. *Id.* § 2604(a)(1)(A).

84. Dalesio, *supra* note 29.

85. For more information on the organization and its environmental mission, see *About*, CAPE FEAR RIVER WATCH, https://capefearriverwatch.org/about/ [https://perma.cc/W8GP-7HXP].

86. Letter including Notice of Intent To Sue from Geoff Gisler & Jean Zhuang, S. Envtl. Law Cent., to Ellis H. McGaughy, Chemours Co. 1–2 (May 7, 2018), https://www.southernenvironment.org/uploads/words_docs/2018_05_07_-_Chemours_60-Day_TSCA_Notice_FINAL.PDF [https://perma.cc/4HY7-T8TF].

87. *Id.* at 3–4.

88. *Id.* at 4 (quoting EPA, Consent Order and Determinations Supporting Consent Order for PMC Substances P-08-508 and P-05-509 36 (2009)).

over whether Chemours has actually recovered and captured that much GenX, arguing that "Chemours'[s] violations are causing imminent danger to human health and safety."[89] Underlying the consent order and the allegations by environmentalists is the precautionary thinking that the company, rather than the community, should bear the burden of uncertainty. While litigation is ongoing—and thus compliance with the consent order is indeterminate—in February 2019, the EPA announced that Chemours had violated the TSCA.[90] Chemours failed to comply with several requirements of the TSCA by not submitting a Pre-Manufacture Notice, Significant New Use Notice, or the Chemical Data Reporting Rule report.[91]

This violation highlights a practical drawback of the precautionary principle: enforcement. The EPA already "requested information from Chemours pursuant to TSCA Section 11 documenting when Chemours first learned about the GenX-related contamination in and around the Fayetteville Works . . . facilit[y], including GenX contamination in drinking water."[92] Yet, Chemours had previously failed to provide that information to the EPA and had already received a notice of violation[93] and revocation of its wastewater permit[94] from DEQ for other failures to comply. The precautionary principle presumes that chemical companies will be forthcoming with information, a presumption that has not borne out. Obviously, not providing information when asked is one breakdown of the underlying assumptions but, again, companies can also (legally) withhold information about chemicals if that information is a "trade secret."[95] When research on chemicals is deemed a trade

89. *Id.* at 6.

90. Letter regarding Notice of Violation of the Toxic Substances Control Act from Diana Saenze, Acting Dir., Waste & Chemical Enf't Div., to Mark Vergnano, President & CEO, Chemours Co., (Feb. 13, 2019), https://www.epa.gov/sites/production/files/2019-02/documents/chemours_tsca_nov_-_cbi_sanitized_-_021318_signed.pdf [https://perma.cc/SV32-PBEU].

91. *Id.* at 2–3. Notably, a lot of the information in the notice of violation is sanitized as "confidential business information." *See id.* at 2.

92. *Id.* at 4.

93. Letter providing Notice of Violation & Intent to Assess Civil Penalty from J. Trent Allen, Regional Supervisor, N.C. Dep't of Envtl. Quality, to Mark P. Vergnano, (Nov. 13, 2017), https://files.nc.gov/ncdeq/GenX/Chemours%20DWR-NOV%20111317.pdf [https://perma.cc/6TLF-EFFA].

94. Letter providing Notice of Partial Suspension and 60-Day Notice of Intent to Partially Revoke NPDES Permit from Linda Culpepper, Interim Director, Div. of Water Res., to Ellis H. McGaughy, Plant Manager, Chemours Co., (Nov. 16, 2017), https://files.nc.gov/ncdeq/GenX/Letter%20November%2011-16-17.pdf [https://perma.cc/Z4ME-XJP7] ("Because of the misrepresentations and inadequate disclosures by Chemours[,] . . . DWR is suspending the Permit provisions that authorize Chemours to discharge process wastewater from the Chemours Fluoromonomers/Nafion Membrane manufacturing area.").

95. *See* Lerner, *A Chemical Shell Game*, *supra* note 21.

secret and practically everyone is withholding it,[96] enforcement is even more difficult because there are no real consequences for intentionally withholding information.

3. Why a Precautionary Principle Framework Alone Will Not Sufficiently Address GenX

In some other respects, response to GenX has relied on the precautionary principle. When NCDHHS released a preliminary health assessment for concentrations of GenX in drinking water, it established a conservative health goal that was meant to be protective for non-cancer health effects in bottle-fed infants, pregnant women, lactating women, children, and adults.[97] The 140 parts-per-million health goal was a modification to the preliminary levels established on June 8, 2017.[98]

NCDHHS lowered the level for several reasons that suggest precaution, including that drinking water is not the only exposure pathway for GenX.[99] NCDHHS held that, "[b]ased on conversations with EPA, there [was] not enough information . . . to identify a specific level of GenX that might be associated with an increased risk for cancer."[100] Rather than completely prohibiting GenX—as would be the approach under a strictly precautionary principle—NCDHHS only considered noncancer risks. This is problematic if GenX is cancerous in humans like other PFAS. Cape Fear will have faced increased exposure—potentially fatal exposure—because regulators failed to follow the precautionary principle.

One of the challenges of using the precautionary principle to regulate GenX is that the chemical is already in use. The principle focuses on preventing harm in the face of uncertainty rather than addressing potential harms once a risk has materialized; that is, it is easier to stop the use of a product before it is employed rather than trying to recall it after it has been adopted.[101] And that

96. *Id.* ("About 95 percent of new chemical notifications, according to a 2005 Government Accountability Office report, include information that is protected as a trade secret, a figure the EPA confirmed as still 'generally accurate.'").

97. N.C. DEP'T OF HEALTH & HUMAN SERVS., QUESTIONS AND ANSWERS REGARDING NORTH CAROLINA DEPARTMENT OF HEALTH AND HUMAN SERVICES UPDATED RISK ASSESSMENT FOR GENX (PERFLUORO-2-PROPOXYPROPANOIC ACID) (July 14, 2017, 3:09 PM), http://ncdenr.s3.amazonaws.com/s3fspublic/GenX/NC%20DHHS%20Risk%20Assessment%20FAQ%20Final%20Clean%20071417%20PM.pdf [https://perma.cc/T24A-LFFJ] (explaining that the limit DHHS adopted is based on the most vulnerable population, the population that drinks the largest volume of water per body weight, bottle-fed infants).

98. *Timeline: Tracking GenX Contamination in NC, supra* note 13.

99. *Id.* (lowering the level multiple folds).

100. *Id.*

101. *See* Applegate, *supra* note 67 at 13 (stating one of two fundamental regulatory policies underlying the precautionary principle is that "anthropogenic harm to human health and the environment should be avoided or minimized through *anticipatory*, *preventive* regulatory controls" (emphasis added)).

underlies one of the biggest critiques of the precautionary principle: practicality. The state has to balance unnecessarily causing panic and shutting down key industries against protecting its citizens. There is understandable fear held by locals that "even a trace of GenX" is too much without certainty that there will be no negative consequences.[102] Yet, the financial cost of shutting down the Fayetteville factory is enormous. Chemours employs over 550 people from the surrounding community, often at high wages.[103] The factory also generates over $1 million in revenue for Bladen County.[104] Under the precautionary principle this is irrelevant, but for the hundreds of employees in the area it is highly significant. Allowing the company to stay but requiring that it make improvements could also generate local tax income and temporary construction jobs to modify the facilities.[105] The next framework seeks to capture these economic costs.

B. *Cost-Benefit Analysis*

1. The Framework Generally

Cost-benefit analyses are common in the U.S. regulatory environment. Under Executive Order 12866 on regulatory planning and review, federal agencies must provide an assessment of anticipated costs and benefits for significant regulatory actions.[106] In its simplest form, cost-benefit analysis focuses on maximizing net benefits of risk regulation: regulation benefits (e.g., avoided healthcare costs) minus regulation costs (e.g., compliance costs, increased prices of goods).[107] Regulators quantify in dollars the costs and benefits at various levels of regulation, making the implicit, "explicit in risk management decision-making."[108] This theoretical framework is attractive

102. Daniel Amparo et al., Opinion, *Op-Ed: Ethical Analysis of GenX*, TECHNICIAN (Dec. 8, 2018), http://www.technicianonline.com/opinion/article_14956fe4-fb49-11e8-a99a-8f64f90d96a5.html [https://perma.cc/74ZG-XF9V].

103. *Fayetteville Works*, CHEMOURS, INC., https://www.chemours.com/Fayetteville-Works/en-us/ [https://perma.cc/K2D7-FHWE]. The average annual wage at Chemours is about $70,000. Christina Haley O'Neal, *Chemours' Impact on Bladen's Economy*, WILMINGTONBIZ (Sept. 7, 2018), http://www.wilmingtonbiz.com/more_news/2018/09/07/chemours%E2%80%99_impact_on_bladen%E2%80%99s_economy/17933 [https://perma.cc/XK4J-UEGH].

104. O'Neal, *supra* note 103.

105. *Id.*

106. Exec. Order 12,866, 58 Fed. Reg. 51,735 (Oct. 4, 1993). Certain statutes can forbid cost considerations. Jennifer Lu, *The EPA Might Change the Way It Weighs Human Health Against Industry Profit*, POPULAR SCI. (June 15, 2018), https://www.popsci.com/epa-cost-benefit-analysis-comment/ [https://perma.cc/49HZ-2YDT]; *see, e.g.*, *Process of Reviewing the National Ambient Air Quality Standards*, U.S. ENVTL. PROTECTION AGENCY (July 10, 2018) https://www.epa.gov/criteria-air-pollutants/process-reviewing-national-ambient-air-quality-standards [https://perma.cc/QB46-7DV7] (describing the assessment and balancing processes in establishing standards under the Clean Air Act).

107. Wood, *supra* note 62, at 225.

108. Wood, *supra* note 62, at 226.

because it presents a rational, objective way to make decisions. A regulator merely identifies the relevant variables, assigns a value to each by relying usually on industry-wide calculations, and chooses the option with the greatest net value.

Unfortunately, there are significant challenges in practice. The cost-benefit analysis is criticized as callous, dependent on information that is unavailable, and value-laden.[109] The criticism that cost-benefit analysis is callous can be attributed to decisionmakers' assignment of monetary values to concepts that feel incalculable, or the resulting decisions that seem to minimize the value of human life. Is it heartless to allow emissions if they result in human death? How can a policymaker assign a numerical value to the loss of life due to cancer?[110] One critique of the cost-benefit framework is that is its detrimentally utilitarian: "Taken to an extreme . . . [it] could be used to count harm to a small group of people as a net benefit to society as a whole."[111] The first concern is ethical—how do we value human life? The second is practical—how do we make policy decisions with insufficient information? For example, how can a policymaker weigh the overall costs of human life lost to cancer if it is hard to determine how carcinogenic a substance is?[112]

The last critique of the cost-benefit framework highlights that although cost-benefit analyses appear to be objective because they rely on numerical analysis, they are ultimately value-laden. For example, individual perceptions of the importance of the environment and human health determine how to measure the cost of clean water or clean air.[113] Even if one could price clean air based on the lack of health complications so that the value of quality air is the money saved from avoiding respiratory problems, it is seemingly impossible to

109. *See* Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U. PA. L. REV. 1553, 1563 (2002).

110. In tort cases, the judicial system asks juries to assign a dollar amount to someone's life, so this is not an impossible challenge. The critique, rather, is whether we want to be assigning such value to life or if there is something inherent in human life that makes the valuation incalculable.

111. Lu, *supra* note 106.

112. *See* LAVE, *supra* note 66, at 8 ("Unfortunately subject areas such as carcinogenicity lack a firm scientific foundation for an analysis of [benefits, costs, and risks in formulating a regulation], and agencies often lack resources to carry out analysis for those areas having a scientific foundation.").

113. *See* Mary Graham, *Environmental Protection & the States: ""Race to the Bottom"" or ""Race to the Bottom Line""?*, BROOKINGS (Dec. 1, 1998), https://www.brookings.edu/articles/environmental-protection-the-states-race-to-the-bottom-or-race-to-the-bottom-line/ [https://perma.cc/LQ8K-JCBB] ("Environmental issues continue to be contentious because they often do pit jobs against cleaner air or more conservation, and sometimes both choices offer economic benefits."). What may also be a challenge within this is the changing EPA approach to cost-benefit analysis. For example, what can be considered a benefit has been changing over the last decade as the EPA and the judiciary weigh whether or not to consider co-benefits (secondary benefits) in these analyses. *See* Lu, *supra* note 106; Times Editorial Board, Opinion, *Editorial: Trump's EPA Is Taking What May Be Its Most Harmful Step Yet*, L.A. TIMES (Jan. 12, 2019), https://www.latimes.com/opinion/editorials/la-ed-epa-mercury-clean-air-20190112-story.html [https://perma.cc/XGG9-HCYJ].

account for the intrinsic value of the environment. As Hope Babcock argues, "Economic approaches . . . discount future risks and undervalue the importance of maintaining a healthy, biologically diverse environment."[114]

2. Application to GenX

As already highlighted, conversations about GenX involve a significant amount of uncertainty.[115] In a cost-benefit analysis, uncertainty arises in two contexts: (1) where to draw the line to include various costs and benefits, and (2) scientific certainty to monetize effects. A "simple" analysis would weigh the economic loss of shutting down the Fayetteville factory[116] against the environmental and health benefits of preventing the release of GenX into the water. But does the economic loss include the loss of expected construction jobs if Chemours modified its facilities?[117] Would the health benefits consider just the short-term effects, or could they include birth defects or developmental delays of children whose mothers were exposed to contaminated water while breastfeeding? Should there be a temporal limit? How about a severity limit? Should only the possibility of cancer be considered or should other, less severe conditions like asthma also be considered? Is the cost of a health effect limited to medical bills, or should it also include lost-work hours or an intangible reduction in quality of life?

These questions are not impossible to answer but require regulators to act based on specific values, which in turn raises an important initial question: Whose values should regulators rely on?

In 1972, Congress enacted the Federal Water Pollution Control Act, commonly known as the Clean Water Act, to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[118] Distinct from federally regulating GenX under the Clean Water Act, should the North Carolina General Assembly weigh this national goal in drafting additional regulations? That is, should national values play a role in state regulation? Many of the major federal environmental laws were promulgated under the fear of a "race to the bottom": if the federal government did not make national programs, states were going to compete to have the laxest regulations to attract business at the expense of the environment and social welfare.[119] That rationale has been heavily criticized in part because states have passed more stringent regulations

114. Hope M. Babcock, *Chumming on the Chesapeake Bay and Complexity Theory: Why the Precautionary Principle, Not Cost-Benefit Analysis, Makes More Sense as a Regulatory Approach*, 82 WASH. L. REV. 505, 524 (2007).

115. *See supra* notes 59–62 and accompanying text.

116. *See supra* Section II.A.2.

117. *Id.*

118. 33 U.S.C. § 1251(a) (2018).

119. Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210, 1210, 1224–28 (1992).

than the federal government or have stepped in to regulate when the federal government has not.[120] And, in fact, recent scholarship suggests a trend towards localized decisionmaking, either at the state or more localized levels.[121] So while there are often partnerships between the state and federal government,[122] it makes sense for North Carolina to prioritize its own goals over national ones to regulate GenX. This follows because emerging contaminants may be specific to a particular state, such as when one manufacturing plant pollutes the rivers of a single state. Notably, North Carolina's state constitution provides even stronger language in favor of protecting state rivers than the Clean Water Act:

> It shall be the policy of this State to conserve and protect its lands and waters for the benefit of all its citizenry, and to this end it shall be a proper function of the State of North Carolina and its political subdivisions . . . to control and limit the pollution of our air and water . . . and in every other appropriate way to preserve as a part of the common heritage of this State its forests, wetlands, estuaries, beaches, historical sites, openlands, and places of beauty.[123]

Furthermore, state law declares that, as a matter of public policy, the water and air resources of the State belong to the citizens of North Carolina, and the State has the "ultimate responsibility for the preservation and development of these resources in the best interest of all its citizens."[124] Practically, this means that in times of weaker state support for environmental regulation, advocates may look to federal law to justify needed regulation. And in times of weaker federal support for environmental regulation or when there is strong state support, the State likely has sufficient authority on its own to regulate GenX and has constitutionally mandated values to guide state legislation.

120. *See, e.g.*, *id.* at 1228 (providing examples for stricter state regulations related to nitrogen oxides and automotive emissions); Shannon M. Roesler, *Federalism and Local Environmental Regulation*, 48 U.C. DAVIS L. REV. 1111, 1111 (2015) ("For example, in the absence of national climate change legislation, municipalities are leading the way in transportation and development strategies to mitigate and adapt to climate change.").

121. *See generally* Roesler, *supra* note 120 (analyzing the role of local authority within environmental law).

122. States are often granted authority to carry out federal programs. Interestingly, the Clean Water Act grants states the authority to deny the certification needed for a federal license or permit for activity that may result in any discharge into navigable waters, essentially giving the state override authority. *See* 33 U.S.C. § 1341 (2018). This is an example of states having additional powers over the federal government, strengthening the argument that states should act first to regulate GenX given that GenX is released into state waters.

123. N.C. CONST. art. XIV, § 5.

124. N.C. GEN. STAT. § 143-211(a) (2017).

3. Why a Cost-Benefit Framework Alone Will Not Sufficiently Address GenX

Regulating GenX based on the cost-benefit framework alone would face the challenges outlined in Section II.B, including information gaps and subjective decisionmaking.[125]

For example, legislating is inherently value-laden. Even if the North Carolina General Assembly keeps a purely local focus (as opposed to incorporating national goals outlined in the Clean Water Act), "whose values should regulators rely on?" is still a difficult question. Should the General Assembly consider Chemours's values if it is a corporation? Given Chemours's influence in the community and corporate personhood, the answer is likely yes, but how should Chemours's values be weighed? Is one multinational corporation equal to one person? In a notable environmental case, *Boomer v. Atlantic Cement Co.*,[126] the highest court in New York crafted a unique remedy to a nuisance claim that considered the needs of a major commercial entity.[127] When neighbors sued for injunctive relief and damages against a large cement company that was creating a nuisance by generating dirt, smoke, and vibrations, the trial court recognized this as a nuisance, granting damages but no injunction.[128] The New York Court of Appeals, however, issued a "conditional" injunction requiring the plant to close only if it did not pay the plaintiffs for the total economic loss to their property present and future.[129] This equitable solution recognized the disparity between the plaintiffs' damages and the consequences of the injunction; the court did not want to effectively shut down the town's economy with an injunction, but all precedent pointed to the doctrine that "where a nuisance has been found and where there has been any substantial damage shown by the party complaining an injunction will be granted."[130]

Boomer provides a few lessons for GenX regulation. First, a court may fashion a remedy that accounts for the needs of a particular economy.[131] That is, Chemours's economic clout may actually matter. The *Boomer* court also weighed the lack of currently available technology to address air pollution in fashioning its remedy.[132] A court, in deciding whether to order an injunction against

125. *See* Ackerman & Heinzerling, *supra* note 109, at 1563.

126. 257 N.E.2d 870 (N.Y. 1970).

127. *Id.* at 874–75.

128. *Id.* at 872, 875.

129. *Id.* at 875.

130. *Id.* at 872.

131. *Id.* at 871 (answering "[t]he threshold question . . . whether the court should resolve the litigation between the parties now before it as equitably as seems possible; or whether, seeking promotion of the general public welfare, it should channel private litigation into broad public objectives" by deciding just the rights of the parties before it).

132. *Id.* at 873.

Chemours's facilities, might consider the ability of Chemours to remove pollution (and perhaps the time it has had to remove pollution). Of course, a major holding of the *Boomer* court was that the judiciary was not the right avenue for addressing major environmental issues.[133] While local groups have sought to force DEQ's hand through litigation,[134] the legislative (and quasi-legislative) branch(es) may be more appropriate. In drafting legislation, the General Assembly can, of course, consider equitable arguments like the *Boomer* court, and weigh Chemours's values.

Furthermore, if the General Assembly should consider the values of an abstract entity like a corporation, shouldn't it also consider the values of the environment, that is, the intrinsic value inherent in nature?[135] Does this suggest that a cost-benefit analysis dooms the Cape Fear River because regulators are incapable of accurate valuation? Is there something that drives us to preserve nature for the sake of nature that is overlooked by economic approaches?[136]

These questions also assume scientific certainty, but the cost-benefit framework is often plagued by significant information gaps. Creating regulations under this framework will not answer whether GenX might cause cancer. Such regulations could however define the factors to consider when determining the overall cost of treating cancer patients. The reality, though, is that regulators and scientists are still stuck on the former question: whether GenX is carcinogenic.[137] Cost-benefit analysis can compare multiple proposed regulations, but it is hard to decide if a program delivering bottled water is better than one requiring improved water treatment processes (regardless of whether the government, individual consumers, or Chemours must pay for the infrastructure) when there is currently no means to remove GenX from the water system. With both the costs and benefits uncertain, a cost-benefit analysis seems premature.

An additional challenge in regulating GenX under a cost-benefit framework is the concept of "co-benefits," other indirect benefits derived from regulation.[138] For example, targeting GenX may eliminate other PFAS from the water and the air, thereby reducing emissions even further or improving health

133. *Id.* at 871.

134. *See supra* notes 13, 54 and accompanying text.

135. *See generally* Donald Kennedy, *Foreword: Valuing Nature*, 16 STAN. ENVTL. L.J., xi, xi–xii (1997) (explaining ecosystem services as well as challenges to valuing nature).

136. For an analysis of how biophilia, humans' innate tendency to seek connections with nature and life, could play out in environmental regulation, see L. Misha Preheim, Note, *Biophilia, The Endangered Species Act, and a New Endangered Species Paradigm*, 42 WM. & MARY L. REV. 1053, 1053–54 (2001).

137. *See supra* Section I.C.

138. Stephen Lee, *EPA Model for Measuring Rule Benefits May Inspire Other Agencies*, BLOOMBERG ENV'T (Jan. 22, 2019), https://news.bloombergenvironment.com/environment-and-energy/epa-model-for-measuring-rule-benefits-may-inspire-other-agencies [https://perma.cc/QAQ5-RVPH].

standards. As these additional benefits are not the objective of regulating GenX, but rather are ancillary to a potential regulation, they are considered "co-benefits." But if potential GenX regulation is not targeted at PFAS broadly, it is unclear if these co-benefits should be deemed a benefit of the regulation. The EPA and the Supreme Court have grappled with this question over the last decade because including co-benefits in an analysis can dramatically increase benefits. This in turn makes environmental regulation more likely as the benefits may then outweigh the costs. Unfortunately, the Court (and subsequent EPA findings) has not clarified how to define benefits. For example, in *Michigan v. EPA*,[139] the EPA conducted a regulatory impact analysis, a particular type of cost-benefit analysis, looking at the financial impact to regulate mercury emitted by power plants.[140] The analysis estimated the annual direct benefits of reducing mercury would be between $4 to $6 million.[141] But any power plant that makes facility or other modifications to reduce mercury would decrease other pollutants as well. The regulatory impact analysis captured these co-benefits, raising the annual benefits of mercury regulations to between $37 and $90 *billion*.[142] Thus, in thinking about whether to regulate mercury, the EPA had a wide range of potential benefits. Given that the regulation would cost power plants an estimated $9.6 billion,[143] including or excluding co-benefits dramatically changed the calculus. Ultimately the EPA did not consider costs at all when determining that regulation was "appropriate and necessary"[144] and was subsequently sued.[145] The Court held that costs must be considered at the time of an appropriate and necessary finding and did not directly address whether co-benefits should be part of that calculus, although the Court hinted that they should not be included in cost.[146]

Whether to evaluate co-benefits in a cost-benefit analysis is still unclear today. Under the Trump Administration, the EPA's new proposal regarding

139. 135 S. Ct. 2699 (2015).

140. *Id.* at 2705–06. Technically, the law was meant to reduce mercury and other "hazardous air pollutants," a specific category of air pollutants. For simplicity's sake, I will categorize *Michigan* as focusing on mercury.

141. *Id.* at 2705.

142. *Id.* at 2706.

143. *Id.* at 2705–06.

144. *Id.* The Clean Air Act required the EPA to study power plant emissions and regulate them if the study found regulation to be "appropriate and necessary." 42 U.S.C. § 7412(n)(1)(A) (2018); *see also Michigan*, 135 S. Ct. at 2705.

145. *Michigan*, 135 S. Ct. at 2699.

146. *Id.* at 2711 ("Even if the Agency *could* have considered ancillary benefits when deciding whether regulation is appropriate and necessary—a point we need not address—it plainly did not do so here."). After *Michigan*, the EPA published a supplemental finding that stated it considered cost and that regulation was appropriate and necessary. However, the EPA did *not* conduct a cost-benefit analysis. Supplemental Finding That It Is Appropriate and Necessary To Regulate Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, 80 Fed. Reg. 230 (proposed Dec. 1, 2015) (to be codified at 40 C.F.R. pt. 63).

mercury for power plants discounted co-benefits.[147] This may be significant for GenX for two reasons. First, GenX emissions are released into the air so that they may ultimately become subject to the Clean Air Act.[148] Thus, adopting the same rationale to regulate GenX—look only at direct benefits—would not be far-fetched. Second, the EPA broke with the 2003 White House Office of Management and Budget guidance telling agencies to analyze co-benefits.[149] It is more likely for the same agency to apply the same guidelines across regulations—meaning the current EPA would likely discount co-benefits if it decides to regulate GenX—particularly when the Supreme Court in *Michigan* left significant discretion to agencies to perform cost-benefit analyses.[150] The uncertainty inherent in measuring the cost and benefits of regulating GenX is compounded by the uncertainty of how even to define a benefit.

C. *Equity-Based Regulation (Environmental Justice)*

1. The Framework Generally

According to the EPA, environmental justice ("EJ") is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies."[151] This equity-based framework recognizes that laws almost always have distributional consequences.[152] As Dr. Robert Bullard, the father of EJ,[153] stated, "Whether by conscious design or institutional neglect, communities of color in urban ghettos, in rural 'poverty pockets,' or on economically impoverished Native-American reservations face some of the worst environmental devastation in the nation."[154] The EJ movement has raised awareness of the idea that racial minorities and low-income communities may not benefit as much from environmental

147. Lee, *supra* note 138.

148. For a basic understanding of the Clean Air Act, see *The Clean Air Act in a Nutshell: How It Works*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/clean-air-act-overview/clean-air-act-nutshell-how-it-works [https://perma.cc/UD27-5L6U] (last updated Jan. 3, 2017).

149. Lee, *supra* note 138.

150. Lee, *supra* note 138.

151. *Learn About Environmental Justice*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/environmentaljustice/learn-about-environmental-justice [https://perma.cc/5LEN-3JYR] (last updated Nov. 7, 2018).

152. *See generally* Richard J. Lazarus, *Pursuing "Environmental Justice": The Distributional Effects of Environmental Protection*, 87 NW. U. L. REV. 787 (1993) (discussing and explaining the distributional inequities resulting from environmental law and how environmental justice may address them).

153. *Biography*, DR. ROBERT BULLARD, http://drrobertbullard.com/biography/ [https://perma.cc/4XYE-4J5K].

154. *Learn About Environmental Justice*, *supra* note 151.

regulations or that they may suffer unequal burdens.[155] In other words, one community may be disadvantaged for the benefit of another and, in environmental regulations, that community is more likely to be poor or minority, or both.[156]

EJ critiques "mainstream" environmental law on three grounds: (1) it fails to account for distribution of environmental harms and benefits, "which is especially important when distribution[s] follow the lines of poverty and race"; (2) it fails to capture the breadth of what an "environment" is and instead focuses on the beautiful outdoors, maintaining an "anti-urban bias"; and, (3) it overvalues "elite forms of advocacy" like litigation and lobbying rather than engaging the full community.[157] Thus, EJ seeks to push environmental law to be more intentional and to strive for greater inclusion—it is the intersection of civil rights and environmental law.[158]

In the last twenty-five years, significant steps have been taken to look more closely at equity-based decisionmaking, but progress has been mixed. In 1994, President Bill Clinton signed Executive Order 12898: "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"[159] which was the first major federal action on EJ. It required all federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."[160] Two decades later and major EJ issues prevail: not all agencies have fulfilled this mandate, there has been internal strife at the EPA over the value of EJ, and race and poverty are still "powerful predictors" of undesirable environmental conditions.[161]

155. Lazarus, *supra* note 152, at 816. For example, racial minorities may lack access to national parks (limited benefits), or be forced to move to make way for the development of roads or power plants (increased burden).

156. For example, one of the critiques of carbon cap-and-trade programs is that offsets, which allow companies to make up for their emissions by reducing emissions elsewhere, prevent pollution reduction in the most polluted areas. *See* Emily Guerin, *Environmental Groups Say California's Climate Program Has Not Helped Them*, NPR (Feb. 24, 2017), https://www.npr.org/2017/02/24/515379885/environmental-groups-say-californias-climate-program-has-not-helped-them [https://perma.cc/S2RH-ZC48].

157. Jedidiah Purdy, *Environmentalism Was Once a Social-Justice Movement*, ATLANTIC (Dec. 7, 2016), https://www.theatlantic.com/science/archive/2016/12/how-the-environmental-movement-can-recover-its-soul/509831/ [https://perma.cc/HYL6-LN5F].

158. *See* Tseming Yang, *Melding Civil Rights and Environmentalism: Finding Environmental Justice's Place in Environmental Regulation*, 26 HARV. ENVTL. L. REV. 1, 1 (2002) ("As a movement seeking to bring the civil rights movement's ideals to environmental protection, the environmental justice movement has shown that environmental political liberalism is not necessarily the same as the political liberalism of those concerned with race and social justice.").

159. Exec. Order No. 12,898, 32 C.F.R. § 651.17 (1994).

160. *Id.* § 1-101.

161. *See* Albert Huang, *The 20th Anniversary of President Clinton's Executive Order 12898 on Environmental Justice*, NRDC: EXPERT BLOG (Feb. 10, 2014), https://www.nrdc.org/experts/albert-

Nonetheless, the Executive Order helped legitimize the EJ movement,[162] and the Office of Environmental Justice ("OEJ") at the EPA has issued numerous tools to promote EJ concerns.[163] For example, in 2016 the OEJ published a Technical Guidance for Assessing Environmental Justice in Regulatory Analysis.[164]

The major criticism of the EJ movement focuses on causality. Critics liken the causality between racial and economic minorities and undesirable environmental conditions to "chicken-and-egg logic" pointing out that it is not always clear "[w]hich came first [to a community], the minorities or the facilities."[165] This critique is more relevant for historical issues like long-standing incinerators, but it is worth mentioning to show that there has not been universal adoption of an EJ framework. A second critique of the EJ frameworks is that EJ is "more procedural than substantive."[166] This is a critique of other environmental regulations that are mostly procedural[167]: they lack any bite to influence substantive environmental change. For example, Executive Order 12898 "lacked requirements that EJ play a determining factor in siting, rulemaking, and permitting decisions," requiring only that agencies adopt and implement an EJ strategy which, as already noted, they had not all completed within twenty years.[168] This critique will be discussed more in relation to GenX below.

huang/20th-anniversary-president-clintons-executive-order-12898-environmental-justice [https://perma.cc/G4H2-FYUG]. Specifically, this article notes that race and poverty are "powerful predictors of students who attend schools near polluting facilities, the location of polluted neighborhoods that pose the greatest threat to human health, hazardous waste facilities, urban heat islands, and access to healthy foods, parks, and tree cover." *Id.*

162. *Id.*

163. *EJ Screen: EPA's Environmental Justice Screening and Mapping Tool*, U.S. ENVTL. PROTECTION AGENCY (2018), https://ejscreen.epa.gov/mapper/ [https://perma.cc/VXY3-WMKJ] [hereinafter *Mapping Tool*].

164. U.S. ENVT'L PROT. AGENCY, TECHNICAL GUIDANCE FOR ASSESSING ENVIRONMENTAL JUSTICE IN REGULATORY ANALYSIS (2016), https://www.epa.gov/sites/production/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf [https://perma.cc/AB6V-9LND] [hereinafter TECHNICAL GUIDANCE].

165. David Monsma, *Equal Rights, Governance, and the Environment: Integrating Environmental Justice Principles in Corporate Social Responsibility*, 33 ECOLOGY L.Q. 443, 455 (2006); *see also* Omar Saleem, *Overcoming Environmental Discrimination: The Need for a Disparate Impact Test and Improved Notice Requirements in Facility Siting Decisions*, 19 COLUM. J. ENVTL. L. 211, 225–31 (1994) (questioning whether minorities are located in areas of higher concentrations of hazardous sites because of overt racism or market forces that drew minorities to the area after siting).

166. *See* J.B. Ruhl & James Salzman, *Climate Change Meets the Law of the Horse*, 62 DUKE L.J. 975, 985, 1002 (2013).

167. *See, e.g.*, Kenneth E. Gray, *NEPA: Waiting for the Other Shoe To Drop*, 55 CHI.-KENT L. REV. 361, 361 (1979) (criticizing the largely procedural National Environmental Protection Act in 1979 by postulating that "NEPA is in danger of becoming a dead letter statute, at least as far as its ability to generate substantive benefits for the environment is concerned").

168. Huang, *supra* note 161.

2. Application to GenX

In the last several decades, greater emphasis has been placed on equitable distribution of environmental benefits and harms. North Carolina is considered the birthplace of the EJ movement[169] and EJ principles may be key to properly regulating GenX.

Equity-based decisionmaking should consider the potential for disproportionate impacts, particularly on population groups of concern: minority, low-income, and indigenous communities.[170] To identify instances when EJ issues may be most salient, the EPA recommends looking at several identifying factors that may contribute to differential impacts, including proximity to emission sources, exposure to multiple stressors, and physical infrastructure.[171] Wilmington, the city at the base of the Cape Fear River, ranks between the eightieth and ninetieth percentile for proximity to hazardous wastes, making the community susceptible to cumulative exposures.[172] The Cape Fear River runs completely through Bladen County (from its northwest corner to its southeast corner), which ranks ninety-fifth out of one hundred counties for health outcomes in the state.[173] This also indicates that the Cape Fear community may be exposed to multiple stressors. "[I]n an assessment of potential EJ concerns, it is important to assess both the potential for higher exposures to a given environmental stressor and the potential for higher susceptibility to adverse effects of the stressor for population groups of concern."[174] Although exact estimates are difficult to assess,[175] about three

169. *See* U.S. Dep't of Energy Office of Legacy Mgmt., *Environmental Justice History*, U.S. DEP'T ENERGY, https://www.energy.gov/lm/services/environmental-justice/environmental-justice-history [https://perma.cc/7E5G-F8DF] (discussing the origins of the EJ movement in the small African-American community protesting the Warren landfill). For more on the EJ movement in North Carolina, see ROBERT D. BULLARD, DUMPING IN DIXIE: RACE, CLASS, AND ENVIRONMENTAL QUALITY 35 (1990).

170. TECHNICAL GUIDANCE, *supra* note 164, at 4–8.

171. TECHNICAL GUIDANCE, *supra* note 164, at 4–8.

172. *Mapping Tool*, *supra* note 163 (select "Select Location" dropdown; then select "Select Location" from the list; then enter "Wilmington, NC" in the box below "Enter a Location or a latitude/longitude text; then press "Go"; next select the "Add Maps" dropdown; then select "EJSCREEN Maps" from the list; then select the "Hazardous Waste Proximity" map under the "Variable" list; then select the "Add to Map" button). Cumulative impacts do not necessarily have to come from the same type of stressor. TECHNICAL GUIDANCE, *supra* note 164, at 18. It is important to consider the hazardous waste generators in the area because "[a]n analysis that considers risks from only one source can inaccurately characterize the potential for health risks if the populations for which risk is being estimated are also exposed to a stressor from the other sources." TECHNICAL GUIDANCE, *supra* note 164, at 18.

173. Robert Wood Johnson Found., *North Carolina Health Outcomes Overall Rank*, COUNTY HEALTH RANKINGS & ROADMAPS, http://www.countyhealthrankings.org/app/north-carolina/2018/rankings/outcomes/overall [https://perma.cc/ZS9G-3FN3].

174. TECHNICAL GUIDANCE, *supra* note 164, at 15.

175. In fact, uncertainty about where wells are located compounds concern.

million North Carolinians rely on well water,[176] a form of "physical infrastructure [that] may contribute to increased exposure."[177] Combined, these factors indicate that the EPA and DEQ may need to contend with serious EJ concerns surrounding GenX. In fact, the Cape Fear River Watch has also framed GenX contamination as a class issue: "[T]here are many people in our community who do not have the ability to buy additional water treatment systems [to treat GenX]. This is environmental injustice—when poor people or people of color do not have the same level of protection from environmental pollution as rich people."[178]

It is unclear how DEQ or the EPA would change their decisionmaking if they recognized GenX as a potential EJ issue. The EPA's Technical Guidance for Assessing Environmental Justice in Regulatory Actions provides suggestions for how to identify and account for EJ concerns.[179] It stresses the importance of meaningful involvement and properly analyzing disproportionate impacts on population groups of concern.[180]

Specifically, meaningful involvement indicates that:

> 1) potentially affected populations have an appropriate opportunity to participate in decisions about a proposed activity [i.e., rulemaking] that will affect their environment and/or health; 2) the population's contribution can influence [the EPA's] rulemaking decisions; 3) the concerns of all participants involved will be considered in the decision-making process; and 4) [the EPA will] seek out and facilitate the involvement of population's potentially affected by EPA's rulemaking process.[181]

Thus, "meaningful involvement" must mean more than making updated information publicly available, as both the state and federal governments have.[182] The EPA needs to engage with, listen to, and actively consider the concerns of the communities surrounding the Chemours facility.

At both the state and federal level, government actors have sought meaningful involvement with mixed reviews. In 2018, the EPA held a

176. *Well Water and Health: Facts & Figures*, N.C. DEP'T HEALTH & HUM. SERVS., https://epi.publichealth.nc.gov/oee/wellwater/figures.html [https://perma.cc/V78U-R3JT] (last updated Dec. 17, 2019).

177. TECHNICAL GUIDANCE, *supra* note 164, at 17.

178. *See GenX—What Happened & What Now?*, CAPE FEAR RIVER WATCH, http://www.capefearriverwatch.org/advocacy/genx-what-happened [https://perma.cc/HZW9-85QZ] (identifying the environmental injustice occurring along class lines as well as racial lines). According to 2016 data, Bladen County is the second poorest county in the State by median income, further compounding the problem. Robert Wood Johnson Found., *supra* note 173.

179. TECHNICAL GUIDANCE, *supra* note 164, at 1.

180. TECHNICAL GUIDANCE, *supra* note 164, at 4–8.

181. TECHNICAL GUIDANCE, *supra* note 164, at 9 (alterations in original).

182. *See Basic Information on PFAS*, *supra* note 4; *GenX Investigation*, N.C. DEP'T ENVTL. QUALITY, https://deq.nc.gov/news/key-issues/genx-investigation/ [https://perma.cc/2XSC-W67U].

community engagement forum in Fayetteville on PFAS contaminations, sharing the latest science and developments on the toxic pollutants and also seeking feedback from individuals directly affected by contamination.[183] While this is an important step for engaging the community, the EPA faced criticism from local non-profit groups for refusing state environmental officials' requests to hold forums in Wilmington and Greensboro as well, two other major cities where PFAS have been detected in the public water system.[184] Even the State, which has engaged more directly, has not gone unscathed. North Carolina held its seventh community information session in December 2018.[185] Despite several sessions, some critics have argued that information dissemination has largely ignored unempowered individuals, such as the homeless.[186]

It also remains to be seen whether stakeholders will influence the EPA since no regulations have been issued on GenX, but state regulators seem to be listening. DEQ has seemingly taken "meaningful involvement" to heart. At the December 2018 meeting, North Carolina officials recognized the importance of community comments in identifying potential problems and pointed to another opportunity to engage: a forthcoming community survey for residents living within ten miles of Chemours.[187] At the December 2018 forum, community members raised concerns about the consent order negotiated by Chemours, DEQ, and Cape Fear River Watch.[188] DEQ accepted public comment on the

183. Sorg, *supra* note 18.

184. *Id.* Admittedly, environmentalists have not been fans of the Trump Administration. *See, e.g.*, Glenn Thrush & Coral Davenport, *Donald Trump Budget Slashes Funds for E.P.A. and State Department*, N.Y. TIMES (Mar. 15, 2017), https://www.nytimes.com/2017/03/15/us/politics/budget-epa-state-department-cuts.html [https://perma.cc/VM4Q-9Y6F (dark archive)] (noting that the Trump administration has slashed almost one-third of the EPA's budget). Yet this criticism is not nearly as serious. After all, the Chemours manufacturing site is located in Fayetteville, *Timeline: Tracking GenX Contamination in NC*, *supra* note 13, so it makes sense to focus on the area closest to the contamination.

185. *Public Information Session About GenX Scheduled for Dec. 11*, N.C. DEP'T ENVTL. QUALITY, https://deq.nc.gov/news/press-releases/2018/11/23/public-information-session-about-genx-scheduled-dec-11 [https://perma.cc/3PDV-L4VM].

186. *See* Allison Ballard, *GenX: Focus Shifts to Environmental Justice*, COASTAL REV. ONLINE (Newport, N.C. July 7, 2017), https://www.coastalreview.org/2017/07/genx-focus-shifts-to-environmental-justice/ [https://perma.cc/M5RJ-CRQC] (highlighting EJ concerns in educating the public, including homeless/unsheltered individuals; speakers "questioned whether diverse communities of southeastern North Carolina had the same awareness about the presence of GenX").

187. Greg Barnes, *Don't Sign Chemours Consent Order, Residents Tell DEQ*, N.C. HEALTH NEWS (Dec. 13, 2018), https://www.northcarolinahealthnews.org/2018/12/13/dont-sign-chemours-consent-order-residents-say/ [https://perma.cc/7KR4-LX99].

188. *Id.* (criticizing the order as "absolutely insane" for "allowing Chemours to pay off $12 million to absolve them of all their infractions"). Interestingly, the Wilmington City Council opposed the order by a vote of four to three, but it is unclear if opposition was based on specific community concerns. *See* Adam Wagner, *What Do Wilmington's State Reps Think About the GenX Order?*, STARNEWSONLINE (Wilmington, N.C. Jan. 10, 2019, 4:00 PM), https://www.starnewsonline.com/news/20190110/what-do-wilmingtons-state-reps-think-about-genx-order [https://perma.cc/6GTV-4JRC].

decision and in February of 2019 issued a new consent order that incorporated community comments.[189]

Explicitly mentioning community concerns ensures meaningful involvement. This allows communities that are being ignored to be able to empirically identify if they have been included in decisionmaking rather than make conjectures about their lack of political power. When DEQ addresses EJ concerns explicitly before acting, the agency can highlight instances when the state has not meaningfully engaged or has ignored an important concern raised by local citizens. It can also recognize the important community work DEQ has done, setting important precedent for future regulators to engage the local community.

3. Why an EJ Framework Alone Will Not Sufficiently Address GenX

There are drawbacks to an EJ model for addressing GenX. First, EJ issues may arise because individuals have lacked the political will to prevent contamination or hazardous siting.[190] Although awareness of EJ issues has grown, as evidenced by federal recognition of EJ concerns, this does not mean that groups have garnered greater political power. In fact, North Carolina's history of racial gerrymandering and other race-related voter suppression tactics[191] undermine the notion that minority groups have political capital to address EJ concerns.

Second, national attention to EJ issues can fluctuate based on priorities.[192] In 2005, EPA Administrator Stephen Johnson tried to remove racial discrimination from the definition of EJ.[193] Although his successor, Lisa

189. N.C. DEP'T OF ENVTL. QUALITY, SUMMARY OF REVISED PROPOSED CONSENT ORDER AND RESPONSE TO PUBLIC COMMENT 1 (Feb. 20, 2019), https://files.nc.gov/ncdeq/GenX/2019-02-20-FINAL-DEQ-Response-to-Comments-on-Proposed-Consent-Order.pdf [https://perma.cc/7ZDB-M6PE].

190. *But see* Saleem, *supra* note 165.

191. Cooper v. Harris, 137 S. Ct. 1455, 1468 (2017) (holding North Carolina's redrawing of two congressional districts after the 2010 census was unconstitutional racial gerrymandering); Vann R. Newkirk II, *The Supreme Court Finds North Carolina's Racial Gerrymandering Unconstitutional*, ATLANTIC (May 22, 2017), https://www.theatlantic.com/politics/archive/2017/05/north-carolina-gerrymandering/527592/ [https://perma.cc/4EUF-JC8U]; *see also* Vann R. Newkirk II, *The Battle for North Carolina*, ATLANTIC (Oct. 27, 2016) https://www.theatlantic.com/politics/archive/2016/10/the-battle-for-north-carolina/501257/ [https://perma.cc/Y3SV-WXVW] (outlining the discriminatory intent of voter ID laws passed in North Carolina); Vann R. Newkirk II, *North Carolina's Voter ID Law Is Defeated, for Now*, ATLANTIC (May 15, 2017), https://www.theatlantic.com/politics/archive/2017/05/north-carolinas-voter-id-law-supreme-court-cert/526713/ [https://perma.cc/W8TW-UT6U] (same).

192. *See, e.g.*, Brady Dennis, *EPA Environmental Justice Leader Resigns, Amid White House Plans To Dismantle Program*, CHI. TRIBUNE (Mar. 9, 2017), http://www.chicagotribune.com/news/nationworld/ct-epa-environmental-justice-leader-resigns-20170309-story.html [https://perma.cc/7KTW-RDAV] (discussing the departure of EPA's assistant administrator for environmental justice at the start of the Trump administration transition in the wake of news that key EJ programs would be defunded).

193. Huang, *supra* note 161.

Jackson, "swiftly re-established an EJ ethos in the agency," EJ advocates have argued that the EPA has paid environmental justice "a lot of lip service . . . [but] failed to make substantive strides forward in implementing EJ policies and rules that significantly impact communities."[194] Even the Technical Guidance for Assessing Environmental Justice in Regulatory Analysis is only that, guidance; it is non-binding.[195] Furthermore, the ongoing[196] Flint, Michigan, water crisis highlights the challenges poor minority communities face even under an EPA committed to EJ issues.[197]

Another challenge is that an EJ lens does not change already existing legislation. While this framework brings attention to the potential disparate impact of environmental regulation, it may be limited in application to actually change that disparate impact. The critique of EJ as being procedural rather than substantive is particularly salient for GenX. The discussions around disproportionate impacts and population groups of concern have not been at the forefront of regulating GenX. It is not clear that the EPA even views GenX as an EJ issue.[198]

194. Huang, *supra* note 161

195. TECHNICAL GUIDANCE, *supra* note 164, at iv.

196. Jonathan Oosting, *Cummings Tells Snyder: 'I Intend To Continue' Flint Water Probe*, DETROIT NEWS (Dec. 19, 2018, 11:31 AM), https://www.detroitnews.com/story/news/local/michigan/2018/12/19/cummings-snyder-continue-flint-water-probe/2362430002/ [https://perma.cc/CAS5-KXWK].

197. *Flint, Federalism, and Environmental Justice in the United States*, MIT PRESS BLOG (Feb. 10, 2016), https://mitpress.mit.edu/blog/flint-federalism-and-environmental-justice-united-states [https://perma.cc/N4CE-52VM] (criticizing the recommitment to EJ issues under Obama EPA in light of Flint: "A financial crisis prompted Michigan Governor Rick Snyder to appoint an Emergency Manager with near complete control of the city, including its drinking water system. When problems with Flint's drinking water began to emerge, following an ill-conceived and poorly-managed decision to switch the source of the city's water supply, the response from state officials was dismissive. Despite repeated efforts by local residents, public health officials, and scientists to raise red flags, the Michigan Department of Environmental Quality (MDEQ) not only failed to prioritize the issue, but agency officials continued to declare the water safe despite mounting evidence of levels of lead that far exceeded national standards. No longer having the authority to govern their own city, Flint's poor, black, and Democratic-voting majority held little sway with the Republican state administration, and the problems spiraled to the point of crisis").

198. There are *not* specific mentions of EJ issues on the parts of the EPA's website focused on GenX or PFAS more broadly. The same applies to the North Carolina DEQ website. I hypothesize that this may be because GenX use has been widespread rather than targeted at a small, historically minority community. *But see* Cammie Bellamy, *Parents Wade into Toxic GenX Issue*, STARNEWS ONLINE (Wilmington, N.C. Sept. 15, 2017, 2:15 PM), https://www.starnewsonline.com/news/20170915/parents-wade-into-toxic-genx-issue [https://perma.cc/VJ52-SPRC] (announcing pilot to provide clean drinking water to low-income students in New Hanover and Brunswick Counties); Mark Hibbs, *Panel To Advise DEQ on Environmental Justice*, COASTAL REV. ONLINE (Newport, N.C. May 4, 2018), https://www.coastalreview.org/2018/05/panel-to-advise-deq-on-environmental-justice/ [https://perma.cc/V9W8-ZYMM] (creating EJ panel to tackle "tough issues like GenX").

III. A PRINCIPLED APPROACH: REGULATIONS SHOULD DRAW FROM EACH FRAMEWORK

As the leading researcher who discovered GenX in the Cape Fear River stated, "Until the knowledge is out there, it is hard to create change."[199] Thus, the discussions around GenX right now heavily focus on understanding the chemical and its health and environmental effects. While this is an important step, a broader look at regulation is imperative so that we can best decide how to manage risk as we better understand it.

Crafting the best response to GenX is inherently complex. By drawing from multiple theoretical frameworks, regulators can blend together a dynamic and intentional regulatory scheme. This Comment cannot solve the contaminant crisis in the Cape Fear River. It can, however, point to important principles that regulators should be considering.

Cost-benefit analysis is the default decisionmaking framework. This is not inherently bad but is improved upon when regulators also incorporate EJ concerns and recognize that there are times when precautionary thinking is necessary. Noah Sachs argues that a "Strong Precautionary Principle," one which puts the burden on firms, not the federal government, to prove safety, may be most appropriate in contexts where "traditional cost-benefit analysis is ill-suited. These contexts involve pervasive uncertainty about the gravity of harm that might result from an activity or the frequency of its occurrence, or compelling equity or distributional concerns."[200] This is the case for GenX. At the same time, there are important economic concerns—the closing of "a major employer and taxbase generator"[201]—that our regulatory framework has been historically inclined to consider. Thus, although proponents of the precautionary principle (or even an equity-based framework) would argue to shut down the Chemours Fayetteville facility, there will be obvious political opposition. Corporations are key constituents, and thus Chemours holds political clout.

In many respects, EJ is not the primary driver of federal action but rather a consideration to account for when taking action. It comes across as an additional layer to add to a regulatory framework. However, regulators should incorporate EJ more explicitly. For example, in partially revoking the Chemours permit, DEQ should have mentioned the particular susceptibilities of surrounding vulnerable communities. Recognizing the failure of compliance and the need to address potentially fatal health consequences points to a precautionary-like approach. The government provided an opportunity for proper self-regulation, and a failure to meet base standards should shift

199. Kulikowski, *supra* note 3.

200. Sachs, *supra* note 77, at 1291.

201. O'Neal, *supra* note 103.

regulation towards precaution, stripping a company of the ability to self-regulate. In this manner, regulation pulls from both perspectives. Admittedly, it is harder then to square these approaches with the cost-benefit analysis. However, a concentrated effort could be used to begin weighing costs and benefits earlier (precautionary principle), affording greater harms to particular communities, or looking at benefits and costs over a longer time frame (equity-based). Thus, the impact of GenX on Fayetteville and the surrounding area must take into effect co-benefits, longer-term impacts, and distributional inequity.

CONCLUSION

Ultimately, "[e]very risk management theory has unique virtues and vices . . . [but the] commonality lies in their purpose, which is to provide insight into whether and how much risk should be mitigated."[202] There are challenges inherent in emerging contaminants that cripple the ability to regulate them, specifically that awareness and understanding of them is emerging. Uncertain science can often seem as if it is the only characteristic that unites this broad category of chemical compounds. Because of differences between individual emerging contaminants, which cover everything from pharmaceuticals to GenX to pesticides, there is not a single law that can adequately address them, nor should there be.[203] Nonetheless, looking at how state and federal regulators address GenX can shed light on how to handle other PFAS contaminants[204] and the theoretical framework to address contaminants of emerging concern more broadly. By looking at GenX through the lens of three frameworks—precautionary principle, cost-benefit analysis, and environmental justice—this Comment seeks to highlight some of the complexities of each framework. A single approach to emerging contaminants is unlikely to be successful. A single approach to just GenX is also unlikely to be successful. The precautionary principle tells us to do something, rather than nothing.[205] For those relying on the Cape Fear River watershed, something—such as access to bottled water and regular informational meetings—is indeed better than nothing. The cost-benefit analysis "can [then] help us decide what specific policy instruments

202. Wood, *supra* note 62, at 228.

203. Wood, *supra* note 62, at 269–70 (addressing pharmaceuticals and personal care products).

204. This is particularly relevant in North Carolina. Sorg, *supra* note 18. ("In fact, fluorinated compounds have been detected in Jordan Lake, Lake Michie near Durham, and in Greensboro's public water supply. The source of Greensboro's contamination is likely the Piedmont Triad International Airport, where fire-fighting foam is used. At least one well in the town of Atlantic in Carteret County also tested high for fluorinated compounds, likely from a nearby military base, where training exercises also use the foam.").

205. *See* Wood, *supra* note 62, at 228 (similar conclusions for pharmaceuticals and personal care products).

would cost and for what gains."[206] When combined with an appreciation for environmental justice, we begin to recognize that different communities may be able to handle different cost burdens and may evaluate benefits differently. This in turn allows for improved risk management.

Ultimately, handling GenX is not going to be a simple problem; the recent spills of chemicals at Chemours highlights that even just stopping the release of GenX into groundwater is not as easy as expected. Yet, by analyzing the underlying theories of environmental regulation, policymakers can seek to make better decisions. And in response to GenX, new approaches and better regulations can emerge.

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206. Wood, *supra* note 62, at 228.

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