ENVIRONMENTAL HEALTH TRUST

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Submitted via email to: NSSimplementationplan@ntia.gov

Re: Environmental Health Trust Comments on the National Telecommunication and Information Administration National Spectrum Strategy

Executive Summary

We thank the National Telecommunication and Information Administration for considering our comments on the National Spectrum Strategy (the "Strategy").[1] The Environmental Health Trust (EHT) is a not-for-profit scientific think tank that promotes a healthier environment through research, education and policy.[2]

On December 12, 2023, Theodora Scarato, Executive Director, and Rola Masri, Director of Government Outreach, of the Environmental Health Trust met with Scott Harris, John Alden, Scott Patrick, Paul Ransom and Jonathan Stefanick of the NTIA Office of Spectrum Management. This comment serves as a follow-up to that meeting.

EHT shares the goal of the NTIA to ensure that the future of technology in the US is as robust, efficient, and sustainable as possible. The ultimate impact of the National Spectrum Strategy is stated on its cover page: *"This Strategy will expand access to advanced wireless broadband networks and technologies, whether*

[1] https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf
[2] www.EHTrust.org

*terrestrial-, airspace-, satellite- or space-based, for all Americans.*" However, expanding wireless networks comes hand-in-hand with proliferation of additional antennas and increased radiofrequency (RF) radiation emissions on newly available spectrum. We submit that responsible spectrum management considers not only the impact of spectrum decisions on networks and devices but also on the environment and all life forms, including humans, animals, plants, and microbes.

The Federal Communication Commission's RF human exposure limits remain almost entirely unchanged since 1996 and they are designed only to protect against heating effects of short term exposures, not biological impacts from long term exposure.[3] An ever growing body of scientific evidence documents adverse effects from RF radiation at exposure levels well below FCC limits[4] with research findings that include cancer, the induction of oxidative stress, epigenetic effects, impacts to neurotransmitters, memory, brain development and damage to the immune, endocrine, hematological and reproductive system. Further, studies have found impacts to tree canopy, plant growth, pollinator health and the orientation, migration and breeding of wildlife.[5] The science clearly indicates that wireless networks create harmful interference in humans as well as flora and fauna.

A study by U.S. Army and Air Force Research Laboratories found that high powered pulsed microwave exposures could reach the same threshold pressures of explosive blast brain and football head impact injuries even at levels considered "safe" and compliant with current FCC RF limits.[6]

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[3] Lin, J. C. (2023). Incongruities in recently revised radiofrequency exposure guidelines and standards. Environmental Research, 222, 115369; International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF), (2022). Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G. Environ Health. Oct 18;21(1):92; Lopez I, Rivera M, Feliz N, Maestu C. (2022) It is mandatory to review environmental radiofrequency electromagnetic field measurement protocols and exposure regulations: An opinion article. Front. Public Health, 24 October; Davis, D., Birnbaum, L., Ben-Ishai, P., Taylor, H., Sears, M., Butler, T., & Scarato, T. (2023). Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks. Current Problems in Pediatric and Adolescent Health Care, 53(2), 101374.

[4] Belpomme, D., Hardell, L., Belyaev, I., Burgio, E., & Carpenter, D. O. (2018). Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective. *Environmental Pollution*, *242*, 643–658; McCredden, J. E., Cook, N., Weller, S., & Leach, V. (2022). Wireless technology is an environmental stressor requiring new understanding and approaches in health care. *Frontiers in Public Health*, *10*; Miller, A. B., Morgan, L. L., Udasin, I., & Davis, D. L. (2018). Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). *Environmental Research*, *167*, 673–683.

[5] Levitt, B. B., Lai, H. C., & Manville, A. M. (2022b). Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: How species interact with natural and man-made EMF. Reviews on Environmental Health, 37(3), 327–406; Thill A, Cammaerts MC, Balmori A. Biological effects of electromagnetic fields on insects: a systematic review and meta-analysis. Rev Environ Health. 2023 Nov 23

[6] A. M. Dagro, J. W. Wilkerson, T. P. Thomas, B. T. Kalinosky, and J. A. Payne, "Computational modeling investigation of pulsed high peak power microwaves and the potential for traumatic brain injury," Sci. Adv., vol. 7, no. 44, pp. 1–10, Oct. 2021, doi: 10.1126/sciadv. abd8405. "Nevertheless, the simulations here have shown that exceptionally intense HPM exposures with incident power densities greater than 1.5 × 106 mW/cm2 (at short pulse durations) may generate intracranial stresses that are similar (±~20 to 200 kPa) in comparison to typical TBI events (sports, vehicle accidents, ballistic impact, etc.). For sufficiently short microwave pulse durations (<τc), large tensile stresses are created in the deep regions of the brain…While the peak power densities used within this simulation study are large, they are achievable with known microwave hardware. For example, to produce a power density of 1 × 106 mW/cm2 at 25 m away from a 40-dBi antenna, a microwave source would require approximately 8 MW of power per pulse. This is within

Further, as documented in Attachment 1 on Regulatory Gaps, there are no federal agencies with health and science expertise engaged in activities related to reviewing the science on health effects of rising environmental RF levels from network infrastructure.

With that in mind we submit these comments. In this document, "**spectrum utilization decisions**" refers to any action, decision, or recommendation by NTIA to allocate, reallocate, or alter the utilization of, spectrum, whether for non-federal use, shared commercial/federal use, or federal use.

**Outline of EHT's Recommendations**
*See details and documentation for each recommendation in linked pages.*

**Recommendation #1: NTIA must not make any spectrum utilization decisions that increase RF exposure until the FCC complies with the U.S. Court of Appeals DC Circuit mandate issued in *EHT et al. v. FCC,* to address record evidence including long term health effects, children's vulnerability and environmental impacts of RF exposure. Page 4**

**Recommendation #2: NTIA must condition any future spectrum utilization decisions that will increase human or environmental RF exposure on (i) creating industry leading premarket testing for long term safety (for humans, flora, and fauna), (ii) ensuring that devices and networks pass such safety testings, and (iii) establishing quarterly post-market health and environmental surveillance along with monitoring and compliance oversight. Because human and environmental health is a paramount concern to the nation's population and economic vibrancy, NTIA must consider treating any spectrum utilization decision as a major federal action requiring an environmental impact statement under NEPA. Page 5**

**Recommendation #3: The Strategy must expressly state that it is United States Spectrum Policy for its wireless networks and devices to compete on safety, and thus ensure the public and environment is protected from harmful radio frequency interference. Page 6**

**Recommendation #4: NTIA must ensure that spectrum is allocated in accordance with the entire public interest, not just certain narrow corporate or agency priorities. Page 8**

**Recommendation #5: Broaden the definition of stakeholders to include public health and environmental health organizations. The Securities and Exchange Commission (SEC) has already alerted industry of the need to include Environmental Health Stakeholders in its Environmental, Social Governance (ESG) proposed rules. Thus is it important for government agencies to be consistent in their broad policy strokes. Page 10**

**ATTACHMENT 1: Today's Regulatory Gap Regarding Radiofrequency Bioeffects**
**ATTACHMENT 2: Radio-frequency Radiation Impacts on the Environment**

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the capabilities of some commercial and military systems, and we therefore consider this as a relevant approximation for the simulations here. However, we also consider some more extreme conditions in the final analysis summary for scaling purposes against known mechanical TBI thresholds." See also Lin, J. C. (2023). A Paradigm Shift? IEEE Microw. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10314707

**ATTACHMENT 3: Radio-frequency Radiation Impacts on Human Health**
**ATTACHMENT 4: Legal and Liability Issues of Wireless**

**Recommendation #1: NTIA must not make any spectrum utilization decisions that increase RF exposure until the FCC complies with the U.S. Court of Appeals DC Circuit mandate issued in *EHT et al. v. FCC,* to address record evidence including long term health effects, children's vulnerability and environmental impacts of RF exposure.**

Neither FCC, nor the Food and Drug Administration (FDA), have yet to address their responsibilities to ensure public health and environmental protection. The FCC has not responded to the August 13, 2021, U.S. Court of Appeals for the District of Columbia Circuit *ORDER* in *Environmental Health Trust et al. v. FCC,* 2021 wherein the court ordered the FCC to "address the impacts of RF radiation on children, the health implications of long-term exposure to RF radiation, the ubiquity of wireless devices, and other technological developments that have occurred since the Commission last updated its guidelines, and…the impacts of RF radiation on the environment." The Court also ordered the FCC to "provide a reasoned explanation for its decision to retain its testing procedures for determining whether cell phones and other portable electronic devices comply with its guidelines."

No federal agency with health or science expertise has evaluated the comprehensive body of scientific research on the human health and environmental impacts of wireless radiation. As stated by the EPA, FDA, and Department of Interior, current FCC guidelines address heating effects of short term exposures only.[7] Current FCC human exposure guidelines are unchanged since 1996 and were based on now antiquated limits developed by ANSI/IEEE C95.1-1992 and NCRP's 1986 Report. These limits identified the level of adverse effects based on studies which exposed a few monkeys and rats to RF radiation for less than one hour, more than 40 years ago. They do not consider the biological effects of non-thermal or long-term low-level exposures of radiofrequency radiation documented in the scientific literature.[8] Current guidelines also do not

[7] Guidelines of the FCC, ICNIRP and IEEE are based on protection for short term heating, not for long term exposures. In 1999, the FDA stated in its Nomination to the National Toxicology Program to study wireless radiation that, "As noted above, the existing exposure guidelines are based entirely on protection from acute injury from thermal effects of RF exposure, and may not be protective against any non-thermal effects of chronic exposures." FDA Nomination from FDA's Center from Device and Radiological Health Radio Frequency Radiation Emissions of Wireless Communication Devices (CDRH) May 19, 1999 https://ntp.niehs.nih.gov/sites/default/files/ntp/htdocs/chem_background/exsumpdf/wireless051999_508.pdf; EPA's Norbert Hankin clarified that the FCC's 1996 RF limits do not protect against all effects stating that, "federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures" in a 2002 letter https://ehtrust.org/wp-content/uploads/4c0f61dc30c3d6bb27d90f53a57c616e.pdf George Brozowski Regional Health Physicist of the EPA's 2014 letter stated, "The standards are intended to prevent adverse health effects that may be associated with tissue heating, but are not intended to address low intensity (nonthermal), longterm (chronic) exposures. Investigation as to whether there may be effects from exposures too low to cause heating is continuing." The US Department of the Interior stated in a 2014 letter to the NTIA that, "the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."

[8] International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF), (2022). Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G. Environ Health. Oct 18;21(1):92.

consider the documented effects of modulations and pulsation on living cells. As the DC Circuit recognized, these antiquated studies are a far cry from properly assessing the health and environmental impacts of modern technology and ubiquitous wireless devices.

**Recommendation #2: NTIA must condition any future spectrum utilization decisions that will increase human or environmental RF exposure on (i) creating industry leading premarket testing for long term safety (for humans, flora, and fauna), (ii) ensuring that devices and networks pass such safety testings, and (iii) establishing quarterly post-market health and environmental surveillance along with monitoring and compliance oversight. Because human and environmental health is a paramount concern to the nation's population and economic vibrancy, NTIA must consider treating any spectrum utilization decision as a major federal action requiring an environmental impact statement under NEPA.**

NEPA Section 106 states: *"An agency shall issue an environmental impact statement with respect to a proposed agency action requiring an environmental document that has a reasonably foreseeable significant effect on the quality of the human environment."*[9]

The attachments below document the significant body of scientific evidence indicating adverse effects to humans and the environment from radiofrequency exposure resulting from spectrum allocation. As set out below, the FCC has consistently abrogated its responsibilities under NEPA. Therefore, it is likely that once NTIA makes a spectrum utilization decision, FCC will not prepare an environmental impact statement (EIS).

As NTIA moves forward with a new National Spectrum Strategy, and given the significant amount of radiofrequency emissions and exposure likely to result from any spectrum utilization decision, NTIA should consider treating every frequency released or proposed for release for non-federal or shared nonfederal use as a major federal action requiring an EIS.

Further, every frequency and modulation should be studied pre and post market for impacts on the environment and human health, before deployment. We recommend quantitative and qualitative risk assessments, including individual and cumulative effects, of spectrum utilization decisions. Such assessments should determine, not only the effects of the frequencies at different power levels but also the effects of the polarized wave forms, including sawtooth/non-sinusoidal waveforms, when they are modulated, pulsed, and otherwise altered to fit the technological needs of non-federal entities.[10] Premarket safety testing of long term

[9] 42 USC 4336
https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section4336&num=0&edition=prelim

[10] Barnes, F., & Freeman, J. E. R. (2022). Some thoughts on the possible health effects of electric and magnetic fields and exposure guidelines. *Frontiers in Public Health*, *10*; Belyaev, I. (2010). Dependence of non-thermal biological effects of microwaves on physical and biological variables: Implications for reproducibility and safety standards. European Journal of Oncology Library, 5, 187–218; Belyaev, I. Y., & Grigoriev, Y. G. (2007). Problems in assessment of risks from exposures to microwaves of mobile communication. *Radiatsionnaia Biologiia, Radioecologiia*, *47*(6), 727–732; Panagopoulos, D. J., Johansson, O., & Carlo, G. L. (2015). Real versus Simulated Mobile Phone Exposures in Experimental Studies. *BioMed Research International*, *2015*, 607053; Panagopoulos, D. J., Johansson, O., & Carlo, G. L. (2015). Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity. *Scientific Reports*, *5*, 14914.; Lai, H., & Levitt, B. B. (2022). The roles of intensity, exposure

exposure to altered frequencies on living things are essential to ensure technology is safe for people and the natural environment.

RF exposures should be monitored nationwide to understand current exposure levels as well as trends over time. A transparent, robust federal RF compliance program is needed to ensure that industry compliance testing is done correctly and that emissions are compliant. The public needs an oversight and enforcement program to investigate, and promptly address non-compliance with fines and mitigation.

Current industry-generated or commissioned pre-construction reports and post-construction testing are largely inadequate, if not inaccurate, in large part because the modeling protocols and programs have not been validated for real world accuracy. There are no up-to-date, minimum standards for preparing RF compliance reports, studies and evaluations nor quality control.

As of June 2023, FCC has not issued updated guidance on how to comply with RF rules, which includes newly licensed frequencies and services, since 1997. The existing guidance, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (FCC OET 65 (1997),[11] which provides assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) adopted by the Federal Communications Commission (FCC) rules, is outdated. Independent inspectors, informed by up-to-date guidance, should be required to carry out on-the-ground measurements post antenna deployments to verify compliance with human exposure limits.

Field compliance reports taking actual measurements can reach different conclusions depending on, for example, the number of measurements, location of measurements in relation to the antennas and the length of measurement in each location. Furthermore, reports are inconsistent regarding the inclusion of peak measurements versus averaged measurements, and the inclusion of actual values versus percentage of FCC limits.

Federal agencies with health and safety expertise should conduct ongoing research reviews, hazard evaluations, and quantitative risk assessments to ensure FCC limits are adequately protective. However, none of these needed regulatory safeguards are in place at this time.

**Recommendation #3: The Strategy must expressly state that it is United States Spectrum Policy for its wireless networks and devices to compete on safety, and thus ensure the public and environment are protected from harmful radio frequency interference.**

Under its authorizing statute (47 USC 901(c)[12]) NTIA shall seek policies:

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duration, and modulation on the biological effects of radiofrequency radiation and exposure guidelines. *Electromagnetic Biology and Medicine*, *41*(2), 230–255; Panagopoulos, D. J. (Ed.). (2022). *Electromagnetic Fields of Wireless Communications: Biological and Health Effects* (1st ed.). CRC Press.; Panagopoulos, D. J., Karabarbounis, A., Yakymenko, I., & Chrousos, G. P. (2021). Human-made electromagnetic fields: Ion forced-oscillation and voltage-gated ion channel dysfunction, oxidative stress and DNA damage (Review). International Journal of Oncology, 59(5), 92.

[11] https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

[12] 47 USC 901
https://uscode.house.gov/view.xhtml?path=/prelim@title47/chapter8&edition=prelim

a) promoting the benefits of technological development for **all users** in the United States;
b) fostering **national safety;**
c) fostering the use of telecommunications resources in a manner that benefits **the public interest**; and
d) furthering **scientific knowledge** about telecommunications. [Emphasis added]

The Strategy's introduction refers to the range of spectrum users, stating:

> *"All of these uses and spectrum demands are important to the Nation and must be protected from harmful radio frequency interference to ensure a high level of service availability and to best serve the public interest."*

The Strategy should protect not only electronic devices from harmful interference, but also the health and safety of the American people.

Strategic Objective 2.1 (Establish a persistent strategic spectrum planning process guided by the best available science and data) should incorporate science and data on the impacts of various telecommunications technologies on **all users**, as required by statute. Electromagnetic related disability is recognized by the US government and multiple other entities.[13] In addition, certain segments of the population are more vulnerable to radiofrequency impacts, including children.[14] The goal of NTIA is to provide connectivity to all Americans, regardless of disability status or age.

Strategic Objective 3.1 (Improve spectrum efficiency and bolster coexistence by facilitating investments in new and emerging technologies) should seek to bolster coexistence not only among different spectrum users, devices, and networks, but also between technology on the one hand and all life forms on the other hand, including humans, plants, animals, and microbes. For example, NTIA's Institute for Telecommunications Sciences could also identify ways to minimize RF emissions from networks and engage in research on wired (instead of wireless) devices and networks to meet connectivity needs.

Strategic Objective 3.2 (Commit to improving collective understanding of the electromagnetic spectrum through coordinated, focused, and sophisticated research and development (R&D)) should include research on how different spectrum management techniques, and different wavelengths, (for example, pulsed, modulated, sawtooth, and other waveforms, as well as multiplexing technologies) differentially affect different lifeforms.

Strategic Objective 4.2 (Improve policymakers' understanding of spectrum considerations) recognizes the need for "leaders at all levels of government, including Tribal governments, need to understand spectrum

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[13] https://ehtrust.org/resources-on-electromagnetic-sensitivity-and-accommodations/

[14] Davis, D., Birnbaum, L., Ben-Ishai, P., Taylor, H., Sears, M., Butler, T., & Scarato, T. (2023). Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks. *Current Problems in Pediatric and Adolescent Health Care*, *53*(2), 101374; Miller, A. B., Sears, M. E., Morgan, L. L., Davis, D. L., Hardell, L., Oremus, M., & Soskolne, C. L. (2019). Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices. *Frontiers in Public Health*, *7*; Redmayne, M., & Johansson, O. (2015). Radiofrequency exposure in young and old: Different sensitivities in light of age-relevant natural differences. *Reviews on Environmental Health*, *30*(4), 323–335;Sage, C., & Burgio, E. (2018). Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development. *Child Development*, *89*(1), 129–136; McCredden, J. E., Cook, N., Weller, S., & Leach, V. (2022). Wireless technology is an environmental stressor requiring new understanding and approaches in health care. *Frontiers in Public Health*, *10*.

issues holistically and have access to spectrum managers and professionals that understand the complexities relative to their interests." Informing policymakers' holistic understanding must include information about the pros and cons of new technologies, so that policymakers can make informed decisions about telecommunications policy. To take an example from transportation policy, we have long recognized that vehicles emit PM2.5 particulate matter. Transportation policymakers need to consider the impact of their decisions not only on travel times and road capacity, but also on the PM2.5 emissions (and the health and environmental impacts thereof) that result from different policy decisions.

Strategic Objective 4.3 (Improve the public's understanding of radio frequency spectrum and raise awareness of its role in everyday life) should include education for the public and state and local decision-makers on the impacts of RF exposure on humans, especially children, and ways to mitigate these impacts.[15] There is already precedent for NTIA engaging in activities like this – for example, NTIA's Task Force on Kids Online Health & Safety intends to provide voluntary "best practice guidance for industry and caregivers seeking to protect minors online."[16] Similarly, a bill currently pending in Congress would direct NTIA to promote cybersecurity literacy among the public.[17]

**Recommendation #4: NTIA must ensure that spectrum is allocated in accordance with the entire public interest, not just certain narrow corporate or agency priorities.**

As spectrum is a finite resource with risks to health and the environment that carry significant negative externalities, it is essential for NTIA to make spectrum recommendations in accordance with the public interest. Based on past history, for example with C-band deployment, when spectrum is reallocated from federal users to commercial users, the density of antennas and of aggregate radiofrequency emissions throughout the United States is dramatically increased.[18] At the same time, these reallocations may incur substantial cost to these federal users, and therefore ultimately to taxpayers and the public at large.

It may be that the optimal economic outcome for the United States is for federal users to retain spectrum, while commercial users increasingly rely on wired, fiber-optic broadband. For example, the Congressional Research Service reported earlier this year that for the Department of Defense to relinquish just 350 MHz of additional C-band would take 20 years and cost "hundreds of billions of dollars"[19] – which is approximately $1 billion of cost to federal users to relinquish 1 MHz of spectrum. The Strategy proposes to study reallocating 2790 MHz. Assuming a similar level of $1 billion of cost to relinquish 1 MHz, reallocating that amount of spectrum could incur nearly $3 trillion of taxpayer costs – without taking into account the negative externalities incurred by commercial users. NTIA should consider whether this is an efficient allocation of

[15] Davis, D., Birnbaum, L., Ben-Ishai, P., Taylor, H., Sears, M., Butler, T., & Scarato, T. (2023). Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks. Current Problems in Pediatric and Adolescent Health Care, 53(2), 101374; Clegg, F. M., Sears, M., Friesen, M., Scarato, T., Metzinger, R., Russell, C., Stadtner, A., & Miller, A. B. (2020). Building science and radiofrequency radiation: What makes smart and healthy buildings. Building and Environment, 176, 106324.
[16] https://www.ntia.gov/category/kids-online-health-and-safety
[17] https://www.congress.gov/bill/118th-congress/house-bill/1360/
[18] Under "Section 6409" (47 USC 1455(a)), existing wireless facilities can be expanded with almost unlimited additional antennas. After C-band became available, a wave antenna deployments occurred under 6409, while claiming preemption over state and local government.
https://uscode.house.gov/view.xhtml?req=(title:47%20section:1455%20edition:prelim)
[19] https://sgp.fas.org/crs/misc/IF12351.pdf

resources in our economy. In addition, the BEAD deployment will be complete long before spectrum under the current Strategy is reallocated from federal users. As a result, all or nearly all Americans by that point will have access to high-speed fiber connectivity at home, work, school, community centers, and other locations – which is and will be significantly faster than that which is provided over wireless

As NTIA is aware, wireless broadband is not best practice, as fiber has far surpassed it in performance, speeds, reliability, latency, cybersecurity, privacy, scalability and has less impact on health and the environment. It would be a huge disservice to the American people for the government to continue to release frequencies to serve wireless broadband that is no longer viable for current and future needs.

The poor performance metrics of wireless broadband costs our states billions of dollars when residents and businesses are held up by unreliable service, low speeds, and issues with cybersecurity[20] and privacy. While wireless upload speeds unreliably peak at 50Mbps, fiber upload and download speeds start at 1000 Mbps and have the capacity to upgrade into Terabyte speeds. Wireless infrastructure fails during inclement weather or when the path of the signal is obstructed. Allowing more wireless broadband investments will perpetuate the digital divide, as bandwidth and latency demands increase.

Wireless broadband presents a major cybersecurity risk. Individuals, institutions and businesses have suffered great losses as wireless signals are easily accessible to hackers. Fiber and current cable infrastructure can reliably offer superior service without these challenges.

Wireless broadband is also a huge energy guzzler. 5G base stations are expected to consume roughly 3 times the power of 4G base stations and more 5G base stations are required to cover the same area.[21] Energy consumption is expected to increase by 61 times from 2020 to 2030 with 5G. One study done by the Federal Environment Ministry of Germany and the German Environment Agency found that video transmission through fiber optics is nearly 50 times more energy efficient than wireless.[22] Research on whole network level assessments of the operational energy use implications of 5G warns that "Energy-intensive user practices contribute to ever-growing levels of data traffic, and counteract[23] the energy-saving potential of 5G efficiency improvements."[24]

In addition, technologies that are fixed in place like smart meters need not communicate wirelessly when they can be better served with a wired connection. We urge the NTIA to not allow spectrum allocations for stationary technologies, including fixed wireless and satellite, that can be served with wired connections.

As BEAD funding grants accelerate the build out of fiber networks, wireless broadband will be less needed. We urge the NTIA to consider performance, speeds, reliability, latency, cybersecurity, privacy, scalability and impacts on health and the environment when making spectrum recommendations, especially when another technology is capable of better meeting the needs.

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[20] https://www.sdxcentral.com/articles/news/att-sounds-alarm-on-5g-security/2019/11/
[21] https://spectrum.ieee.org/5gs-waveform-is-a-battery-vampire
[22] https://www.umweltbundesamt.de/en/press/pressinformation/video-streaming-data-transmission-technology
[23] https://www.etsi.org/images/files/ETSIWhitePapers/WP_47_GFDI.pdf
[24] Williams, Laurence and Sovacool, Benjamin K. and Foxon, Timothy J., The energy use implications of 5G: Reviewing whole network operational energy, embodied energy, and indirect effects (January 13, 2022). Renewable and Sustainable Energy Reviews 157 (2022) 112033, Available at SSRN: https://ssrn.com/abstract=4008530

**Recommendation #5: Broaden the definition of stakeholders to include public health and environmental health organizations. The Securities and Exchange Commission (SEC) has already alerted industry for the need to include Environmental Health Stakeholders in its Environmental, Social Governance (ESG) proposed rules. Thus is it important for government agencies to be consistent in their broad policy strokes.**

The Strategy states that "the Nation must implement a long-term planning process in which stakeholders work together openly, consistently, and transparently (subject to national security and competition constraints) to address users' current and future spectrum requirements," and "Establishing a new framework for collaboration will facilitate robust and regular dialogue and interchanges of data, building trust and transparency among all stakeholders."

"On May 25, 2022, the US Securities and Exchange Commission (the "SEC") proposed two form and rule amendments seeking to enhance and standardize disclosures related to environmental, social and governance ("ESG") factors considered by funds and advisers, and to also expand the regulation of the naming of funds with an ESG focus. These proposed rules follow the landmark SEC proposal announced on March 21, 2022 requiring public companies to disclose extensive climate-related information in their SEC filings." SEC Proposes Amendments to Rules to Regulate ESG Disclosures for Investment Advisers & Investment Companies | White & Case LLP (whitecase.com) (Last accessed, 9pm, January 2, 2024).

Broadening the definition of stakeholders to include a wider range of groups including public health and environmental health organizations such as Environmental Health Trust as well as community groups and organizations. More outreach needs to be done with the American public so they understand this issue and can participate in the process.

**ATTACHMENT 1: Today's Regulatory Gap Regarding Radiofrequency Bioeffects**
**ATTACHMENT 2: Radio-frequency Radiation Impacts on the Environment**
**ATTACHMENT 3: Radio-frequency Radiation Impacts on Human Health**
**ATTACHMENT 4: Legal and Liability Issues of Wireless**

We are happy to provide the NTIA with more information and resources.

Sincerely,

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# ATTACHMENT 1: Today's Regulatory Gap Regarding Radiofrequency Bioeffects

Regulatory gaps within current spectrum usage have a potential for negative impacts to human health and the environment.

1. Currently there is no federal registry for all wireless facility sites, cell towers, or small wireless facilities.
2. The US has no measuring, monitoring or mapping of environmental RF levels.
3. There is no federal oversight and enforcement program in place to ensure wireless facilities emissions are within limits.
4. There is no ongoing research review and no hazard evaluation or quantitative risk assessment of FCC limits or the full body of bio-effects literature (including impacts to brain development, reproduction or immune system) by any federal agency with health and safety expertise.
5. There are no pre-or post-market studies for new wireless communication frequencies, antenna systems and technologies to ensure safety.
6. There is no agency with activities related to research or review of the health and environmental impacts of ambient environmental exposures from the RF emissions of cell towers, 4G, 5G and other telecommunication network antennas.
7. There is no agency with activities related to impacts of RF exposures to wildlife, animals and the natural environment (plants and trees.)
8. There is no agency carrying out activities related to evaluating the health and environmental impacts of 5G modulations nor for new technologies (i.e, that will use higher frequencies as well as new beamforming antenna systems, modulations and pulsation).

**The Environmental Protection Agency (EPA) and RF Guideline Background**

FCC RF exposure limits are guidelines only, as they are not federally developed safety standards[25] whereby agencies reviewed the totality of scientific evidence, performed risk analysis and identified a level of adverse effect to base a limit that would ensure adequate public protection. Such a process never happened.

The EPA was actively engaged in research to develop proper federal safety standards for RF that would protect humans from both thermal and non-thermal impacts, as it had been tasked to do by several federal agencies. However, just as the EPA was poised to release its RF limit recommendations in 1995[26] the EPA

[25] The FCC Website Policy on Human Exposure to Radiofrequency Electromagnetic Fields states, "At the present time there is no federally-mandated radio frequency (RF) exposure standard.https://www.fcc.gov/general/fcc-policy-human-exposure

[26] In 1995 the EPA had briefed both the FCC and the National Telecommunications and Information Administration regarding its two Phases of activities related to the development of RF exposure safety standards. Phase 1 would address only short-term thermal impacts of RF radiation but "does not include modulation, chronic exposure or non thermal [heating] impacts." Phase 2 would address modulated and nonthermal exposures and result in the final guidelines. See *Memorandum from Robert F. Cleveland, Office of Engineering and Technology to FCC Secretary, Ex Parte Presentation by U.S. Environmental Protection Agency (March 22, 1995)*
Three months later, EPA informed the FCC that its final RF guidelines "are essentially complete" and entering the review phase which would include a review by the Radiofrequency Interagency Work Group as well as stakeholders.

was defunded from all such activities. The FCC then promulgated limits based on recommendations developed by industry/military connected groups (ANSI/IEEE C95.1-1992 and NCRP's 1986 Report). At that time, the EPA specifically recommended[27] that an "updated, comprehensive review of the biological effects" be initiated as the IEEE and NCRP recommendations were based on pre-1986 studies.[28]

Although the FCC's 2013 inquiry stated, "Since the Commission is not a health and safety agency, we defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe," there has been no updated federal review since 1996.

Yet, in 2019, when the Commission issued its decision not to update its exposure limits, it stated that it "took into account" views from other expert agencies and standard-setting organizations. The FCC interpreted the silence of federal agencies to mean agreement with the 1996 guidelines, stating in its 11/9/2020 brief that, "no other agency advocated tightening the limits" and "the agency reasonably concluded that the weight of the scientific and health evidence, and particularly the judgment of federal agencies expert in health matters, demonstrated that no changes were warranted." As mentioned earlier, the DC Circuit, in, *EHT et al. v. FCC*, rejected the FCC's conclusion as "arbitrary and capricious" and in violation of the Administrative Procedures Act.

In July 8, 2020, Lee Ann B. Veal, Director of the EPA Radiation Protection Division Office of Radiation and Indoor Air wrote[29] Theodora Scarato, EHT Executive Director, that "EPA's last review was in the 1984 document Biological Effects of Radiofrequency Radiation[30]. The EPA does not currently have a funded mandate for radiofrequency matters."

Federal agencies have not shown a review of the totality of the science (including impacts to the nervous, reproductive and immune systems of humans and animals) to issue such a "judgment." The reality is that federal agencies are not engaged in researching and evaluating the numerous biological effects of RF to humans, flora and fauna. That is why federal agencies such as the EPA did not submit meaningful input to the FCC's Inquiry. They have not been funded or directed to provide a determination or judgment.

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*Letter from E. Ramona Trovata, EPA, Office of Radiation and Indoor Air, to Richard M. Smith, Chief, FCC, Office of Engineering and Technology (June 19,1995)*

[27] EPA Submission to ET Docket 93-62 "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation state, "The FCC should consider requesting the NCRP to revise its 1986 report to provide an updated, comprehensive review of the biological effects on RF radiation and recommendations for exposure criteria."

[28] As the EPA stated to the FCC, "The 1992 ANSI/IEEE standard is based on literature published before 1986, except for a few papers on RF shock and burn. The cut-off date for the literature review supporting the NCRP recommendations is 1982."

[29] *Letter from Lee Ann B. Veal, Director of the Radiation Protection Division, U.S. Environmental Protection Agency to Theodora Scarato, Executive Director, Environmental Health Trust, (July 8, 2020)https://ehtrust.org/wp-content/uploads/EPA-Director-Letter-on-EMFs-to-Theodora-Scarato-July-8-2020.pdf*

[30] U.S. Environmental Protection Agency, 1984 Report Biological Effects of Electromagnetic Radiation https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=300065H1.TXT

**The Federal Communications Commission (FCC)**

The FCC has minimal to non-existent regulatory activities to ensure RF compliance for wireless networks. In several other countries, government agencies monitor RF levels regularly, review industry reports, measure a certain percentage of sites for compliance every year, penalize operators for non compliance, and transparently post RF levels for the public.[31] Not in the USA.

Environmental Health Trust gave a brief presentation on the policies of other countries at the National Spectrum Managers Association 2023 Annual Spectrum Management Conference.[32]

According to the FCC, "The FCC does not have a comprehensive, transmitter-specific database for all of the services it regulates. … In some services, licenses are allowed to utilize additional transmitters or to increase power without notifying the FCC. Other services are licensed by geographic area, such that the FCC has no knowledge concerning the actual number or location of transmitters within that geographic area."[33] With no comprehensive transmitter-specific database for all the services regulated by the FCC, and the ability for licenses to utilize additional transmitters and increase power without notifying the FCC, how are radiofrequency exposure levels monitored to remain within FCC guidelines?

Furthermore, according to the FCC, "The FCC does not have the resources or the personnel to routinely monitor the exposure levels at all of the thousands of transmitters that are subject to FCC jurisdiction. … In addition, the FCC does not routinely perform RF exposure investigations unless there is a reasonable expectation that the FCC exposure limits may be exceeded."[34] With no routine monitoring of RF exposure levels, people and the environment are at risk of exposures to RF levels that exceed current FCC guidelines.

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[31] Examples of governments with a national program to monitor environmental levels of radiofrequency and/or measure cell tower emissions for compliance with government exposure limits include: France, Australia, Austria, Brussels Belgium, Switzerland, India, Israel, United Kingdom, Thailand, Croatia, Lithuania, Spain, Hungary, Italy, Netherlands, Greece, Turkey, French Polynesia, Senegal,Monaco, Bhutan, Gibraltar, Bulgaria, Tunisia, China, Bahrain, Norway , Brazil, Malta, Ireland, Romania
(France even has 5G monitoring stations, Australia Telco posts RF info at ACMA EME Checker . Countries such France, Switzerland, Greece, and Belgium now have robust RF monitoring programs with RF measurements posted online in an easy to understand website that members of the general public can easily navigate, such as a map where you simply click on antenna/tower locations to see the latest measurements and how they compare to the country's limits. Greece's National Observatory of Electromagnetic Fields is operated by the Greek Atomic Energy Commission with 500 sensors since 2015. In India, telecommunications companies are to self-certify compliance at: 1. Launch, 2. With any modification/change and 3. On a biennial basis. In addition the country also states they audit 5% to 10% of sites annually on a random basis and all reports are posted on their EMF dedicated website. https://tarangsanchar.gov.in/EMFPortal/DoT Penalties are Rs. 10 lakh per BTS per incidence. For the year 2022, they reported 320 of the 11,61,281 base stations they tested had emissions exceeding regulatory limits resulting in penalties for the telecom service providers. India's RF public exposure limits are set at 10% of ICNIRP levels.

[32] See Conference site at https://www.nsma.org/conferences/nsma-presentations-2023/ Video of Theodora Scarato at https://youtu.be/NNJUT-ZQcqE?si=GtL9k_IEezuEmiUK&t=1597

[33] FCC RF Safety FAQ
https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety

[34] FCC RF Safety FAQ
https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety

The FCC is not ensuring that RF exposure levels are compliant as it has no monitoring or oversight program in place. The FCC has stated that, "There have been a few situations around the country where RF levels in publicly accessible areas have been found to be higher than those recommended in applicable safety standards."[35] A 2014 investigation by the Wall Street Journal "Cellphone Boom Spurs Antenna-Safety Worries[36] found "one in 10 sites violates the rules, according to six engineers who examined more than 5,000 sites during safety audits for carriers and local municipalities." Since then, FCC rules that have mandated automatic approvals for adding antennas at existing cell sites and "streamlined" placement of new 5G/4G facilities by preempting state and local authority, have resulted in massive antenna proliferation nationwide.

Studies have found that environmental RF levels generated from RF emissions of cell towers, base station network antennas, and other wireless systems have significantly increased over the last few decades, with higher levels in urban areas and in areas of closer proximity to wireless network antennas, especially in locations within the main beams of the antennas.[37] As an example, a 2018 multi-country study found ambient RF measurements in Los Angeles, California now 70 times higher than levels measured in the City in the late '70s, as part of a twelve-city study by the FCC and EPA.[38]

The FCC has never done an environmental impact statement on the individual or cumulative impacts of its spectrum auctions, which have raised $233 billion to date, nor on the allocation of these proceeds to various programs to deploy wireless networks. The FCC has not considered those funding decisions under NEPA, and so have not considered them to be major federal action. In 1986, the FCC categorically excluded most of its actions from NEPA review.[39]

The FCC relies on licensees to measure exposure levels and prepare environmental assessments (EA) if

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[35] FCC RF Safety FAQ
https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety

[36] *"It's like having a speed limit and no police," said Marvin Wessel, an engineer who has audited more than 3,000 sites and found one in 10 out of compliance.*Cellphone Boom Spurs Antenna-Safety Worries Many Sites Violate Rules Aimed at Protecting Workers From Excessive Radio-Frequency Radiation
https://www.wsj.com/articles/cellphone-boom-spurs-antenna-safety-worries-1412293055?mod=WSJ_hpp_MIDDLE_Video_second

[37] Brown, R. (2022). Assessment of radiofrequency radiation intensity on 35 Main Streets throughout Pennsylvania, USA during the fall of 2021. *American Journal of Multidisciplinary Research & Review*. 1(4). 8-20;Baltrėnas, P., Buckus, R., & Vasarevičius, S. (2012). Research and evaluation of the intensity parameters of electromagnetic fields produced by mobile communication antennas. *Journal of Environmental Engineering and Landscape Management*, *20*(4), 273–284; Bhatt, C. R., Redmayne, M., Billah, B., Abramson, M. J., & Benke, G. (2017). Radiofrequency-electromagnetic field exposures in kindergarten children. *Journal of Exposure Science & Environmental Epidemiology*, *27*(5), 497–504; Boussad Y, Chen XL, Legout A, Chaintreau A, Dabbous W. (2022) Longitudinal study of exposure to radio frequencies at population scale. Environ Int.Apr;162:107144 ; Mazloum, T., Aerts, S., Joseph, W., & Wiart, J. (2019). RF-EMF exposure induced by mobile phones operating in LTE small cells in two different urban cities. *Annals of Telecommunications*, *74*(1), 35–42.; Urbinello, D., Joseph, W., Verloock, L., Martens, L., & Röösli, M. (2014). Temporal trends of radio-frequency electromagnetic field (RF-EMF) exposure in everyday environments across European cities. *Environmental Research*, *134*, 134–142.

[38] Sagar, S. et al. (2018). Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context. *Environment International*, Volume 114, 297-306.

[39] Federal Register at page 14999
https://www.govinfo.gov/content/pkg/FR-1986-04-22/pdf/FR-1986-04-22.pdf
47 CFR 1.1306
https://www.ecfr.gov/current/title-47/section-1.1306

needed and self-report any exceedances or potential exceedances.[40] It is indisputable that NEPA is a federal obligation yet the FCC has delegated to the licensees and the carriers the determination of whether a Categorical Exclusion applies. Carriers have a due diligence checklist with different requirements to check off yet this document is never submitted to the FCC if the applicant determines that the facility is categorically excluded; the FCC has no records of carriers doing their due diligence unless the review finds a potentially significant environmental effect that triggers an EA, which they submit. If nothing is triggered on the checklist, then the applicant starts building without the public having access to the checklist and measurements, and no ability to refute or comment on the project.

**The Food and Drug Administration (FDA)**

The FDA does not regulate, have activities related to, nor have authority regarding the RF emissions of cell towers, cell tower antennas, network infrastructure, or 5G facilities. Further, in regards to cell phones the FDA has not shown an evaluation of the totality of the science. Non cancer issues, such as headaches, oxidative stress, brain development, impacts to wildlife, and any studies on vulnerable populations such as pregnant people, children or the medically vulnerable have not been evaluated by the FDA in any report or evaluation shared with the public.

The FDA's very **limited activities** related to cell phones and cancer include a now outdated literature review (with science ending in 2018) focused solely only on cell phones and cancer.[41] This literature review, done by anonymous individuals (rather than transparently presented experts) is focused only on cancer and omits all non cancer studies such as research on brain development, reproduction, or synergistic effects. The review focused only on cell phones and omitted research on Wi-Fi, 5G, 4G or other RF sources. The review is a literature review and not a systematic review nor is it a hazard or risk analysis nor is it an evaluation of FCC cell tower radiation limits, despite being presented in this way. Several experts sent letters to the FDA[42]

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[40] FCC Public Notice – April 27, 2000, YEAR 2000 DEADLINE FOR COMPLIANCE WITH COMMISSION'S REGULATIONS REGARDING HUMAN EXPOSURE TO RADIOFREQUENCY EMISSIONS https://www.federalregister.gov/documents/2000/05/05/00-11237/year-2000-deadline-for-compliance-with-commissions-regulations-regarding-human-exposure-to

[41] FDA, Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer

[42] 2019/2020 Letters to the FDA Regarding Inaccurate Information on the NTP and FDA Website
Letter calling for a retraction of FDA signed by several scientists including Ronald Melnick PhD, former National Institutes of Health Scientist, Samuel Milham MD, former Head of the Chronic Disease Epidemiology Section, Washington State Department of Health; David Carpenter MD, Director of the Institute for Health and Environment at University of Albany's School of Public Health, former director of the Wadsworth Laboratory of the New York State Department of Health, Lennart Hardell MD, PhD, Professor Department of Oncology, Faculty of Medicine and Health Dr. Anthony Miller, Professor Emeritus of University of Toronto and World Health Organization Senior Advisor
Ronald Melnick PhD's individual letter to the FDA on the National Toxicology Program study
Albert Manville PhD, retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Wash. DC HQ Office (17 years); Senior Lecturer, Johns Hopkins University
Prof. Tom Butler of the University College in Cork, Ireland's letter to the FDA
Igor Belyaev, PhD, Dr. Sc. Head, Department of Radiobiology of the Cancer Research Institute, Biomedical Research Center of the Slovak Academy of Science letter to the FDA
Paul Heroux PhD, McGill University
Alfonso Balmori, BSc statement to the FDA

criticizing the literature review for numerous reasons including the fact that it does not follow any scientifically accepted protocols for risk or hazard assessment.

The FDA's 2021 and 2022 Annual reports of the Center for Devices and Radiological Health have zero mention of the issue of cell phones or cell towers or wireless electromagnetic radiation. The 2022 to 2025 Report on Strategic Priorities has nothing on the issue of RF radiation.[43] The FDA has not shown any evidence of monitoring RF bioeffects research via new agency reports, meetings or budget allocations on the issue.

The Government Accountability Report on 5G (GAO 2020) clarified that the FDA and other organizations "only reviewed a subset of the relevant research" and stated in regards to the FDA Literature Review that "The assessment focused on cancer-related animal and human studies of frequencies below 6 GHz."

FDA Statements

> "The FDA does not regulate cell towers or cell tower radiation. Therefore, the FDA has no studies or information on cell towers to provide in response to your questions."
> Ellen Flannery, Director, FDA Policy Center for Devices and Radiological Health to a California mother with a cell tower on her street who asked the FDA about safety, July 11, 2022

> "Under the law, FDA does not review the safety of radiation-emitting consumer products such as cell phones and similar wireless devices before they can be sold, as it does with new drugs or medical devices."
> FDA Website until 2019 -

> "We don't have jurisdiction over cellphone towers since those are environmental emitters."
> Email From FDA's David Kassiday in 2016

The Environmental Health Trust issued a "Report on FDA Activities on Cell Phones and Radiofrequency"[44] which documents the lack of adequate research review and misleading information put forward by the FDA. While the FDA webpages and cell phone cancer literature review seem to assert that safety is assured, the FDA has not adequately evaluated the totality of the science to reach any such safety or risk conclusion.

**National Toxicology Program (NTP)**

In 1999, the FDA requested the NTP perform large scale animal studies on cell phone radiation stating,[45] "A significant research effort, including well-planned animal experiments, is needed to provide the basis to assess the risk to human health of wireless communications devices."

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[43] https://www.fda.gov/media/155888/download

[44] https://ehtrust.org/wp-content/uploads/EHT-Report_-Report-on-FDA-Activities-Related-to-Cell-Phones-and-Radiofrequency-Radiation-2.pdf

[45] FDA CDRH nomination of NTP to Study RFR_Nomination Background: Wireless Communication Devices

The findings of the NTP's $30 million animal study were released in a 2018 final report which found that long term exposure to RF was associated with two types of cancer in male rats, schwannoma of the heart and glioma of the brain,[46] with the NTP's highest level of evidence.[47] Further, the NTP notably found significant increases in DNA damage (Smith-Roe et al., 2020), as well as the induction of cardiomyopathy of the right ventricle in male and female rats. The later Ramazzini Institute studies found elevated incidence of the same tumors the NTP found - heart schwannomas in male rats - despite the Ramazzini Institute use of much lower RF radiation exposures than the NTP which were intended to mimic cell tower base station environmental exposures (Falcioni et al., 2018; Vornoli et al., 2019).

Analysis of the NTP data according to current risk assessment guidelines concluded that U.S. government FCC limits should be lower by 200 to 400 times to protect children (Uche & Naidenko, 2021). Several published reviews conclude that the current body of evidence indicates RF radiation is a proven Group 1 human carcinogen (Miller et al 2018, Peleg et al 2018, Carlberg and Hardell 2017, Belpomme et al 2018,).

However, the FDA stated that they "disagreed" with the NTP findings[48]. The DC Circuit rejected FDA's statement, saying "we find them to be of the conclusory variety that we have previously rejected as insufficient."[49]

**National Cancer Institute (NCI)**

Although the NCI has a lengthy web page on cell phones, the NCI has not performed any type of safety evaluation, nor any formal research review. The NCI has repeatedly stated that "Neither the literature reviews, nor the fact sheets, make safety determinations." (Letter from NCI to Scarato).

When directly asked about cell phone safety issues by the New Hampshire Commission on 5G[50], the National Cancer Institute responded, *"As a Federal research agency, the NCI is not involved in the regulation of radiofrequency telecommunications infrastructure and devices, nor do we make recommendations for policies related to this technology…Our sister agencies, the FDA as well as the FCC, retain responsibility for reviewing guidance on safety concerns and informing the public if those circumstances change."*

The NCI signed onto a one paragraph letter in response to the FCC Inquiry on RF Human Exposure Rules in 2013 simply thanking the FCC for "FCC's interest in continuing to work closely with NIH and other federal

[46] M. Wyde et al., 2018; M. E. Wyde et al., 2018 https://ntp.niehs.nih.gov/whatwestudy/topics/cellphones
[47] https://ntp.niehs.nih.gov/whatwestudy/testpgm/cartox/criteria
[48] FDA Press Release, Statement from Jeffrey Shuren, M.D., J.D., Director of the FDA's Center for Devices and Radiological Health on the National Toxicology Program's report on radiofrequency energy exposure, November 1, 2018
[49] EHT et al.v FCC, supra
[50] New Hampshire Commissioner Denise Ricciardi asked the NCI, "What is the NCI opinion on the safety of cell phones? If you have one, please share your scientific documentation. The NCI responded, "The FDA and FCC are the responsible federal agencies with authority to issue opinions on the safety of these exposures. As a Federal research agency, the NCI is not involved in the regulation of radiofrequency telecommunications infrastructure and devices, nor do we make recommendations for policies related to this technology." page 31 of the New Hampshire Commission Report on 5G https://www.gencourt.state.nh.us/statstudcomm/committees/1474/reports/5G%20final%20report.pdf

agencies with expertise in public health for guidance and expertise on this matter." However, NCI never submitted a substantive, meaningful comment regarding the adequacy of FCC guidelines, nor a systematic research review or evaluation regarding carcinogenicity or any other health issue as the NCI has not engaged in such activities.

**Centers for Disease Control (CDC)**

The CDC has no research activities related to EMF bioeffects. There has been no research review or evaluation by CDC experts regarding carcinogenicity or any other health issue. While the CDC does have webpages on cell phone radiation and wireless wearables, FOIAs show several were drafted with the help of an industry consultant**.**

**National Institute for Occupational Safety and Health (NIOSH)**

NIOSH has no current activities related to non ionizing EMFs. Although U.S. NIOSH scientists long have recommended precautionary measures to minimize risk from occupational RF exposure[51] and developed recommendations to reduce extremely low frequency EMF,[52] protective policies were never further developed or implemented.

**Department of Labor, Occupational Safety and Health Administration (OSHA)**

OSHA currently is not engaged in bioeffect activities.
On July 1, 2015 OSHA wrote the FCC that, "RF emissions are not on OSHA's active regulatory agenda, so we have not conducted a comprehensive literature review or risk assessment on RF hazards" and "OSHA does not appear to have a particularized program in place to ensure worker safety with regard to RF exposure from the wide variety of RF transmitters regulated by the Commission. … we are not aware that OSHA has adequate resources to ensure compliance with our limits for occupational/controlled exposure among our licensees and grantees."

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[51] December 1979 Radiofrequency (RF) Sealers and Heaters (80-107) | NIOSH | CDC
"Absorption of RF energy may also result in "nonthermal" effects on cells or tissue, which may occur without a measurable increase in tissue or body temperature. "Nonthermal" effects have been reported to occur at exposure levels lower than those that cause thermal effects. While scientists are not in complete agreement regarding the significance of reports of "nonthermal" effects observed in laboratory animals, NIOSH believes there is sufficient evidence of such effects to cause concern about human exposures. NIOSH and OSHA recommend that precautionary measures be instituted to minimize the risk to workers from unwarranted exposure to RF energy."

[52] See "Precautionary Strategies to Reduce Worker Exposures to Extremely Low Frequency (ELF) Magnetic Fields, a Possible Carcinogen" by Joseph D. Bowman, PhD, of the Engineering and Physical Hazards Branch at the National Institute for Occupational Safety (NIOSH) Slide presentation to the Collaborative on Health and the Environment (Bowman 2016). Listen to the presentation at https://www.healthandenvironment.org/partnership_calls/18482

OSHA was actively engaged in RF bioeffect activities in previous decades. The agency had developed elements for a Comprehensive RF Protection Program in the mid 90s[53] that was never implemented. An OSHA representative also participated in the now defunct RF Interagency workgroup.

**Inaccurate Statements by Elected Officials**

There is a lack of appropriate oversight in Congress due to the FDA and FCC's lack of full transparency regarding RF safety and their regulatory activities. Agencies should transparently state that they have not reviewed the research on health issues such as impacts to memory, epigenetic impacts and impacts to the environment (including pollinators). Agencies should also clearly state that the regulations do not address long term effects. The FDA should clarify that it has no authority nor judgment regarding health impacts from environmental levels of RF exposure from network antennas (including 5G, 4G, small cells, macro cell towers, or unlicensed antennas). The Congressional Committees tasked to provide oversight are not even aware this issue is in need of accountability.

**Inaccurate statements by elected officials regarding the involvement of federal agencies on 5G and RF bioeffects.**

U.S Senator Schumer's February 6, 2023 Letter states "*Rest assured that as additional studies on microwave radiation and RF exposure are published by scientists and reviewed by government agencies…"Many other federal agencies, such as the EPA, FDA, NIOSH, OSHA have been actively involved in monitoring and investigating issues related to RF exposure."* Yet EPA, NIOSH, and OSHA are not actively involved.

U.S. Representative Scott Fitzgerald's November 5, 2021 letter states that, "In addition to the FCC, Federal health and safety agencies such as the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) have been actively involved in monitoring and investigating issues related to radio frequency (RF) exposure." Yet EPA, NIOSH, and OSHA are not actively involved.

Representative Doris Matsui stated in a December 20, 2023 letter[54] that "*the monitoring and investigation of RF exposure on public health is a collaborative effort between several federal agencies. Since 1996, the FCC has required all wireless communications devices sold in the United States to meet minimum guidelines for safe human exposure to RF energy. RF exposure standards are developed by subject matter experts such as the Institute of Electrical and Electronics Engineers (IEEE) and the National Council on Radiation Protection and Measurements (NCRP) and are used by federal, state and local governments to regulate the teleservice industry and protect public health. These regulators and experts have not found conclusive,*

[53] Presentation on April 12, 1995 by Robert A. Curtis, Director US DOL/OSHA Health Response Team to the National Association of Broadcasters at the Broadcast Engineering Conference Las Vegas, NV
https://www.osha.gov/radiofrequency-and-microwave-radiation/role-of-rf-measurements
[54] https://ehtrust.org/wp-content/uploads/Representative-Doris-Matsui-Letter-on-5G-December-20-2023.pdf

*significant or causal evidence to suggest that 5G is harmful to humans."* Yet there is no collaborative effort in regards to bioeffects.

Senator Diane Feinstein, September 6, 2021, stated, without evidence, "Since 1996, it has been the FCC's policy to cooperate with industry, expert agencies, and health and safety organizations to ensure that guidelines continue to be appropriate and scientifically valid." Yet expert agencies such as *EPA, NIOSH, and OSHA* with health and science expertise are not working with FCC on this topic.

## ATTACHMENT 2: Radiofrequency Radiation Impacts on the Environment

No U.S. agency or international authority has ever acted to review research on wireless radiation effects on the environment nor set exposure limits to ensure protections for birds, bees, trees and wildlife.[55,56] It is a critical regulatory gap.

In 2014, the U.S. Department of Interior wrote a letter to the NTIA detailing several published studies showing impacts of wireless radiofrequency radiation (RFR) to birds stating that, "There is a growing level of anecdotal evidence linking effects of non-thermal, non-ionizing electromagnetic radiation from communication towers on nesting and roosting wild birds and other wildlife." It further stated, "However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."[57]

Significant research has accumulated indicating serious environmental effects of RF, yet with no review by federal agencies. On August 13, 2021, the United States Court of Appeals for the District of Columbia Circuit ruled in our case against the FCC (*EHT et al. v FCC*),[58] stating "we find the Commission's order arbitrary and capricious in its complete failure to respond to comments concerning environmental harm caused by RF radiation." The Commission also "completely failed even to acknowledge, let alone respond to, comments concerning the impact of RF radiation on the environment. That utter lack of a response does not meet the Commission's obligation to provide a reasoned explanation for terminating the notice of inquiry."[59] Despite the 2021 court order, the FCC has remained silent. It has taken no action to justify its refusal to update its 1996 wireless radiation exposure guidelines .

In 2021 and 2022 a three-part landmark research review by U.S experts of over 1,200 studies on the effects of non-ionizing radiation to wildlife entitled "Effects of non-ionizing electromagnetic fields on flora and

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[55] Levitt, B. B., Lai, H. C., & Manville, A. M. (2021). Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions. *Reviews on Environmental Health*.

[56] Levitt BB, Lai HC and Manville AM II (2022) Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach. Front. Public Health 10:1000840. doi: 10.3389/fpubh.2022.1000840

[57] https://www.ntia.doc.gov/files/ntia/us_doi_comments.pdf

[58] Final Court Decision EHT et. al v. the FCC 8/13/2021 https://www.cadc.uscourts.gov/internet/opinions.nsf/FB976465BF00F8BD85258730004EFDF7/$file/20-1025-1910111.pdf

[59] https://www.cadc.uscourts.gov/internet/opinions.nsf/FB976465BF00F8BD85258730004EFDF7/$file/20-1025-1910111.pdf

fauna" found adverse effects in all species studied at even very low intensities. Findings included impacts to orientation, migration, reproduction, mating, nest, den building and survivorship.[60] [61] [62]

In a review published in *Environment International* on the ecological effects of RF-EMF, 70% of the studies reviewed found RF had a significant effect on birds, insects, other vertebrates, organisms, and plants, with development and reproduction in birds and insects being the most strongly affected.[63] Biologists caution that non ionizing electromagnetic radiation is a critical factor in the decline of pollinator and insect populations.[64]

A 2023 systematic review and meta-analysis of studies on the biological effects on insects of non-ionizing electromagnetic fields, including cell tower and Wi-Fi radiation, was published in the journal Reviews on Environmental Health, finding the "vast majority of studies found effects, generally harmful ones" with toxic effects such as impacts to reproduction and immune health occurring at legally allowed exposure levels. [65]

**Pollinators at Risk: Higher Exposures to Insects From 5G and Higher Frequencies**

- The study "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz" by Thielens et al 2018 published in Scientific Reports found that for the 4 insects studied (western honeybee, australian stingless bee, beetle, locust), exposure at and above 6 GHz could lead to an increase in absorbed power between 3–370% (a factor if over 3 times.) The researchers concluded that "this could lead to changes in insect behavior, physiology, and morphology over time…"

- A follow up study on the honeybee entitled "Radio-Frequency Electromagnetic Field Exposure of Western Honey Bees" published in Scientific Reports by Thielens et al (2020) modeled exposure in various life cycle stages (worker, drone, larva, and queen) and combined the data with in-situ measurements of environmental RF-EMF exposure near beehives in Belgium in order to estimate realistic exposure and absorbed power values. Again, they found even a relatively small shift of 10% of environmental incident power density from frequencies below 3 GHz to higher frequencies will lead to a relative increase in absorbed power of a factor higher than 3.

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[60] Levitt, B. B., Lai, H. C., & Manville, A. M. (2021). Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions. *Reviews on Environmental Health*.

[61] Levitt, B. B., Lai, H. C., & Manville, A. M. (2021). Effects of non-ionizing electromagnetic fields on flora and fauna, part 1. Rising ambient EMF levels in the environment. *Reviews on Environmental Health*, *37*(1), 81–122.

[62] Levitt, B. B., Lai, H. C., & Manville, A. M. (2021). Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: How species interact with natural and man-made EMF. *Reviews on Environmental Health*, *37*(3), 327–406.

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- In a subsequent study, researchers modeled the exposures of 2.5 to 100 GHz into the honeybee brain and vital organs in Estimation of the Specific Absorption Rate for a Honey bee Exposed to Radiofrequency Electromagnetic Fields from 2.5 to 100 GHz," by Jeladze et al (2023) and found relatively higher SAR values are observed at 12, 25, and 40 [GHz] frequencies in the 4.8 - 8 W/Kg range, especially for the brain tissue. The SAR values varied depending on exposure parameters such as the direction of the incident plane wave, polarization, frequency, and body peculiarities. The authors conclude that, *"based on the obtained results, we can conclude that the exposure to high-frequency RF-EMFs on honey bees might have an undesired impact, which can cause an attenuation of the vital functions of this important insect."*

- "Radio-frequency exposure of the yellow fever mosquito (A. aegypti) from 2 to 240 GHz," published in PLOS Computational Biology, which found that for the given incident RF power, the absorption increases with increasing frequency between 2 and 90 GHz with a maximum between 90 and 240 GHz. Even at the same incident field strength, the power absorption by the mosquito is 16 times higher at 60 GHz than at 6 GHz.
  For 120 GHz, this increase is even larger compared to 6 GHz, with a factor 21.8. The absorption was highest in the region where the wavelength matches the size of the mosquito. The authors conclude that, "In the future, the carrier frequency of telecommunication systems will also be higher than 6 GHz. This will be paired with higher absorption of EMF by yellow fever mosquitoes, which can cause dielectric heating and have an impact on behavior, development and possibly spread of the insect."

**Impacts on Plants**

A 2017 review "Weak radiofrequency radiation exposure from mobile phone radiation on plants" found physiological and/or morphological effects in 89.9% of studies reviewed.[66]

> "Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies, especially the frequencies between (i) 800 and 1500 MHz ($p < 0.0001$), (ii) 1500 and 2400 MHz ($p < 0.0001$) and (iii) 3500 and 8000 MHz ($p = 0.0161$)."

Trees are also at risk from wireless. A field monitoring study spanning nine years involving over 100 trees found damage on the side of the trees facing transmitting cell antennas.[67] Researchers have released subsequent reports documenting continued impacts to tree canopy from cell tower antennas.[68,69] Other RF effects include impacts to leaf, shoot, seedlings of Aspen trees. [70]

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Environmental Health Trust has developed a website focused on the science of wildlife and wireless at wildlifeandwireless.org.

## ATTACHMENT 3: Radiofrequency Radiation Impacts on Human Health

Extensive published scientific evidence indicates that wireless radiofrequency (RF) radiation at levels far below FCC limits can cause cancer,[71] increased oxidative stress,[72] genetic damage,[73] structural and functional changes of the reproductive system,[74] memory deficit,[75] behavioral problems[76], and neurological impacts.[77]

*EHT et al. v. FCC the U.S. Court of Appeals for the D.C. Circuit 2021*[17] also ruled the FCC ignored scientific evidence on negative health effects from long term wireless radiation exposure at current allowable levels, especially in regards to children, whom the American Academy of Pediatrics states[78] are more vulnerable to wireless radiation. The court ordered the FCC to examine the record evidence regarding long term exposure to children, health effects unrelated to cancer and environmental impacts. To date, the FCC has not responded. This landmark ruling highlights how no federal health agency has reviewed the full body of current research to ensure current safety standards are protective.

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[78] AAP Letter to the FCC Chairman calling for the FCC to open up a review of RF guidelines (7/12/2012), AAP Letter to US Representative Dennis Kucinich in Support of the Cell Phone Right to Know Act 12/12/2012, AAP to FCC Commissioner Mignon Clyburn and FDA Commissioner Margaret Hamburg calling for a review of RF guidelines 8/29/2013

The state of New Hampshire commissioned a study on the Environmental and Health Effects of Evolving 5G Technology and issued a final report[79] in 2020 with 15 recommendations including: requiring setbacks of all wireless transmitters from residences, businesses and schools, adopting a statewide position to encourage fiber optics to the premise, acknowledging the need for further studies to outline clinical symptoms related to RF exposure, developing RF safety limits to protect the environment, among other recommendations.

In 2022, the Pittsfield, Massachusetts Board of Health sent a cease-and-desist order to shut down a Verizon cell tower. The order [80] issued to Verizon states "Whereas, soon after the facility was activated and began transmitting, the City started to receive reports of illness and negative health symptoms from residents living nearby the facility,...The negative health symptoms the affected residents have reported include complaints of headaches, sleep problems, heart palpitations, tinnitus (ringing in the ears), dizziness, nausea, skin rashes, and memory and cognitive problems, among other medical complaints. … Whereas, as further documented below, the neurological and dermatological symptoms experienced by the residents are consistent with those described in the peer-reviewed scientific and medical literature as being associated with exposure to pulsed and modulated Radio Frequency ("RF") radiation, including RF from cell towers."

A major 2022 review of the existing scientific literature on cell tower radiation and health found associations with radiofrequency sickness, cancer and changes in biochemical parameters.[81] For example, a study published in Electromagnetic Biology and Medicine on people living near cell antennas found significant biochemical changes in the blood. This study evaluated effects in the human blood of individuals living near mobile phone base stations compared with healthy controls living more than 300 meters from a base station. The group living closer to the antennas had statistically significant higher frequency of micronuclei and a rise in lipid peroxidation in their blood; these changes are considered biomarkers predictive of cancer.[82]

According to Dr. Linda Birnbaum, Scientist Emeritus and Former Director of the National Institute of Environmental Health Sciences and National Toxicology Program of the National Institutes of Health, "Aware that the FCC's 1996 limits lacked the underpinning of solid scientific data regarding long term health effects, the FDA requested large-scale studies by the National Toxicology Program (NTP) and in 2018 the NTP studies found clear evidence of an association with cancer in male rats.[83] Additionally, the NTP found heart damage and DNA damage, despite the fact that the animals were carefully exposed to non-heating RFR levels long assumed to be safe. The Ramazzini Institute animal studies[84] used even lower

[79] https://www.gencourt.state.nh.us/statstudcomm/committees/1474/reports/5G%20final%20report.pdf
[80] https://ehtrust.org/wp-content/uploads/Pittsfield-Health-Board-Cell-Tower-Order-to-Verizon-April-11-2022-FINAL-REDACTED.pdf
[81] A. Balmori (2022). Evidence for a health risk by RF on humans living around mobile phone base stations: From radiofrequency sickness to cancer. *Environ. Res., 214 (2022), Article 113851* https://doi.org/10.1016/j.envres.2022.113851
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[83] National Toxicology Program Radiofrequency Radiation https://ntp.niehs.nih.gov/whatwestudy/topics/cellphones/index.html
[84] Falcioni et al., Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station

RFR lower exposures to approximate cell tower emissions and also found increases of the same tumor type. The NTP studies were carefully controlled to ensure exposures did not significantly heat the animals. The animal study findings in combination with human studies indicate adverse effects from non heating levels of radiofrequency.

A review paper on corporate risk entitled "Limiting Liability with Positioning to Minimize Negative Health Effects of Cellular Phone Towers" reviewed the "large and growing body of evidence that human exposure to RFR from cellular phone base stations causes negative health effects." The authors recommend restricting antennas near homes and within 500 meters of schools and hospitals to protect companies from future liability.[85]

## ATTACHMENT 4: Legal and Liability Issues of Wireless

U.S. mobile operators have been unable to get insurance to cover liabilities related to damages from long term exposure to radiofrequency emissions for well over a decade.[86]

It is notable that in 2000, the Ecolog Institute Report on radiofrequency health effects, commissioned by T-Mobile and DeTeMobil Deutsche Telekom MobilNet, recommended an RF exposure limit 1000x lower than the FCC's current power density limit after reviewing the research on biological effects, including impacts to the immune system, central nervous system, hormones, cancer, neurotransmitters and fertility.[87] Insurers rank 5G and electromagnetic radiation as a "high" risk,[88] comparing the issue to lead and asbestos.[89] A 2019 Report[90] by Swiss Re Institute, a world leading provider of insurance, classifies 5G mobile networks as a "high", "off-the-leash" risk stating, "Existing concerns regarding potential negative health effects from electromagnetic fields (EMF) are only likely to increase. An uptick in liability claims could be a potential

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[89] Lloyd's of London Report on Electromagnetic Fields "Electromagnetic fields from mobile phones: recent developments." Lloyd's Emerging Risks Team Report, November 2010; **2016 Austrian Accident Insurance Institute (AUVA) ATHEM Report** "Investigation of athermal effects of electromagnetic fields in mobile communications." ; Business Insurance (2011) **White paper explores risks that could become 'the next asbestos'**
See also Factsheets on Legal Liability of Cell Towers at https://ehtrust.org/wp-content/uploads/Legal-Liability-Cell-Tower-Radiation-Health-Effects-3.pdf

[90] Swiss Re 5G Report"Off the leash – 5G mobile networks" https://www.swissre.com/institute/research/sonar/sonar2019/SONAR2019-off-the-leash.html PDF https://ehtrust.org/wp-content/uploads/Swiss-Re-SONAR-Publication-2019-excerpt-1.pdf

long-term consequence" and "as the biological effects of EMF in general and 5G in particular are still being debated, potential claims for health impairments may come with a long latency."

Due to their understanding of the magnitude of this future financial risk most insurance plans have "electromagnetic field exclusions" applied as the market standard.[91] As an example, Portland Oregon Public School Insurance states,[92] "Exclusions: This insurance does not apply to: Bodily injury, personal injury, advertising injury, or property damage arising directly or indirectly out of, resulting from, caused or contributed to by electromagnetic radiation, provided that such loss, cost or expense results from or is contributed to by the hazardous properties of electromagnetic radiation."

Wireless and non-ionizing electromagnetic radiation are defined as a type of "pollution" by wireless companies themselves. According to pg. 10 of the Verizon Total Mobile Protection Plan, "Pollution" is defined as "The discharge, dispersal, seepage, migration or escape of pollutants. Pollutants means any solid, liquid, gaseous, or thermal irritant or contaminant including smoke, vapor, soot, fumes, acid, alkalis, chemicals, artificially produced electric fields, magnetic field, electromagnetic field, sound waves, microwaves, and all artificially produced ionizing or nonionizing radiation and/or waste." Similar definitions for pollution are in the product protection plans for AT&T, Sprint, Verizon, and T-Mobile.

Wireless companies inform shareholders of RF risk[93] but not the communities impacted by the infrastructure.[94] Companies clearly inform shareholders that companies may incur significant financial losses related to non-ionizing electromagnetic fields. Corporate investor warnings by companies such as T-Mobile, AT&T, Verizon, Vodafone and Crown Castle are contained in their Annual Reports, and Form 10-K (or Form 20-F or 40-F for foreign companies) with the Securities and Exchange Commission (SEC). For example, Crown Castle states in their 10-K tax filing that:

> *If radio frequency emissions from wireless handsets or equipment on our communications infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues.*
>
> *The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us.*
>
> *Public perception of possible health risks associated with cellular or other wireless connectivity services and wireless technologies (such as 5G) may slow or diminish the growth of wireless companies and deployment of new wireless technologies, which may in turn slow or diminish our growth. In particular, negative public perception of, and regulations regarding, these perceived health*

[91] Electromagnetic Field Insurance Policy Exclusions Cell Phone Radiation and EMFs - Environmental Health Trust
[92] page 30 https://ehtrust.org/wp-content/uploads/Portland-Public-School-2017-18-Excess-Liability0D0A-policy-1.pdf
[93] Corporate Company Investor Warnings in Annual Reports 10k Filings Cell Phone Radiation Risks - Environmental Health Trust
[94] https://ehtrust.org/key-issues/corporate-company-investor-warnings-annual-reports-10k-filings-cell-phone-radiation-risks/

*risks may slow or diminish the market acceptance of wireless services and technologies. If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."*

Verizon stated in its 10-K for 2022 under the section "Legal and Regulatory Risks" that:

*"We are subject to a substantial amount of litigation, which could require us to pay significant damages or settlements. We are subject to a substantial amount of litigation and claims in arbitration, including, but not limited to, shareholder derivative suits, patent infringement lawsuits, wage and hour class actions, contract and commercial claims, personal injury claims, property claims, environmental claims, and lawsuits relating to our advertising, sales, billing and collection practices. In addition, our wireless business also faces personal injury and wrongful death lawsuits relating to alleged health effects of wireless phones. or radio frequency transmitters. We may incur significant expenses in defending these lawsuits. In addition, we may be required to pay significant awards or settlements."*