An Open Letter on the Environmental and Health Effects of 5G and Telecommunications Infrastructure

I write to bring to your attention critical scientific and technical information justifying an immediate moratorium on 5G as called for by more than 400 scientists and supported by thousands of medical doctors[1]. Independent public health and medical experts worldwide are requesting immediate reductions in both public exposure to microwave wireless radiation and a halt to the densification of wireless infrastructure.

Environmental Health Trust (EHT) is a nonprofit think tank and policy organization, founded in 2007, dedicated to identifying and reducing environmental health hazards. EHT provides independent scientific research and advice on controllable environmental hazards to local, state, and national governments. Today, we write to advise you of the published scientific grounds establishing why and how to avoid major health and environmental impacts from the installation of 5G wireless telecommunications facilities and associated 4G wireless infrastructure in neighborhoods, parks and wilderness.

The transmissions to and from proposed 5G wireless installations are radiofrequency emissions that are an environmental pollutant found to cause cancer (in both experimental animals and humans), DNA damage, neurological damage and other adverse health and environmental effects (e.g., on birds, bees, and trees) according to internationally recognized authoritative research. The prestigious institutions that have conducted these studies include the U.S. National Toxicology Program, the nation's premier testing institute, and the Ramazzini Institute, a foremost testing center in Italy.

The current guidelines put forth by the self-appointed, self-monitored, minority viewpoint of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), upon which some government limits are based, are not protective of health as they are not based on documentation of safety for long term exposure. Furthermore, none of the limits were developed to ensure safety to flora and fauna. As the Natural Resources Defense Council has argued in U.S Courts, an environmental impact assessment should be performed before building out these networks.

ICNIRP Limits Do Not Protect People, Wildlife or the Environment

The exposure guidelines developed by ICNIRP, and which many countries rely on to set radiofrequency guidelines, are based on the outdated and proven erroneous assumption that thermal effects are the only harm from radiofrequency radiation. These guidelines do not protect people or wildlife from biological effects of chronic low level non thermal exposures.

[1] "Small Cells, Mini Cell Towers, Wireless Facilities and Health: Letters from Scientists on the Health Risk of 5G," Environmental Health Trust, last modified September 20, 2017.

In 2020 Environmental Health Trust filed historic legal action against the FCC calling on the FCC to fully review the record and update its 25-year-old wireless radiation exposure guidelines for radio-frequency radiation (RFR) from cell phones, cell towers, Wi-Fi, 5G and other wireless communication devices[2]. The lawsuit Environmental Health Trust et al. v. the FCC has been featured in Washington DC Top News and Bloomberg Law[34].

As our case against the FCC lays out, research on harmful impacts to the developing brain of children was not factored into the standard setting decisions of these groups, nor do these groups consider adverse impacts on male and female reproduction or DNA damage that has been found to occur in published research studies.

The Natural Resources Defense Council filed an **amicus brief** in our case on the need for environmental review signed onto by Mayors and Councilmembers from Maryland, Massachusetts, Michigan, California and Hawaii. Attorney **Joe Sandri** filed an Amicus Brief with a statement by Dr. Linda Birnbaum, former Director of the National Institute of Environmental Health Sciences of the National Institutes of Health and former Director of the National Toxicology Program (NTP) who detailed the findings of the NTP and concluded, "Overall, the NTP findings demonstrate the potential for RFR to cause cancer in humans." The **Building Biology Institute** and **Kleiber family also** filed critical briefs on injuries sustained from exposures allowed by FCC exposure guidelines." [5]

Numerous Countries Have Much Stronger Limits than ICNIRP

The following is a sampling of countries with cell tower network radiofrequency radiation (RF) limits (maximum permissible limits) far more stringent than ICNIRP limits: Belarus, Bulgaria, China, Russia, Belgium, Chile, Greece, India, Israel, Italy, Liechtenstein and Switzerland[6789 10].

In 2011 the Parliamentary Assembly of the Council of Europe issued Resolution 1815: "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.[11 12]" A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours." Resolution 1815 specifically states that governments "reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation

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[2] Environmental Health Trust et al. v. Federal Communications Commission https://ehtrust.org/eht-takes-the-fcc-to-court/
[3] Bloomberg Law: U.S. FCC Faces Skeptical Appeals Judges in Radiation Emissions Case
[4] Washington DC Top News: (WTOP) "Federal appeals court hears case on FCC's 5G safety standards"
[5] Amicus of NRDC: Natural Resources Defense Council , Amicus of Attorney Joe Sandri including declaration of Dr. Linda Birnbaum, former Director of the National Institute of Environmental Health Sciences Amicus of Catherine Kleiber Amicus of the Building Biology Institute
[6] Global Health Observatory Data Repository, "Exposure limits for radio-frequency fields (public)," World Health Organization, last modified May 31, 2017.
[7] Ting Wu et al., "Safe for Generations to Come," *IEEE Microw Mag* 16, no. 2 (March 2015): 65‑84.
[8] Huai Chiang, "Rationale for Setting EMF Exposure Standards," as cited in Wu, Rappaport and Collins, 2015.
[9] Rianne Stam, "Comparison of international policies on electromagnetic fields (power frequency and radiofrequency fields)," National Institute for Public Health and the Environment, 2017.
[10] Mary Redmayne, "International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)," *Electromagnetic Biology and Medicine* 35, no. 2 (March 2015): 176-185.
[11] Committee on the Environment, Agriculture and Local and Regional Affairs, Resolution 1815: "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment," Parliamentary Assembly of the Council of Europe, May 6, 2011.
[12] Parliamentary Assembly of the Council of Europe, Resolution 1815 Final Version, May 27, 2011.

Protection, which have serious limitations, and apply ALARA [as low as reasonably achievable], covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

While many European countries have stronger limits based on their framework of precaution, countries such as India, China and Russia have much lower limits than ICNIRP and are "science based[13]." Their limits are more stringent because their scientists completed research indicating adverse health effects at nonthermal levels of exposure. According to Russian radiation experts who have studied microwaves for decades, the following health hazards are likely to be faced in the near future by children who regularly use mobile phones: disruption of memory, decline in attention, diminished learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to stress, and increased epileptic readiness. For these reasons, special recommendations on child safety from mobile phones have been incorporated into the current Russian mobile phone standard."[14] China's cell tower limits are based on science showing effects which include behavioral, neurological, reproductive abnormalities, and DNA damage[15].

In 2012, India's National Ministry of the Environment and Forest issued a report on the potential impacts of communication towers on wildlife with a focus on birds and bees, citing hundreds of research studies that found adverse effects. Recommendations from the Ministry include, "Introduce a law for protection of urban flora and fauna from emerging threats like ERM/EMF as conservation issues in urban areas are different from forested or wildlife habitats."[16] This research was published in the journal Biology and Medicine concluding that "out of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies." As a result of this research, the government tightened their allowable levels of radiofrequency radiation to 1/10th of ICNIRP limits[17].

We note that these more stringent limits of some countries still *do not assure safety* as harm has been found at levels far far lower than FCC/ ICNIRP limits[18]. Research has found power levels do not adequately characterize the biological impact from exposure as wireless signals are complex and power level is only one of numerous other characteristics of exposure that can influence study outcomes. As stated in the monograph of the International Agency for Research on Cancer (IARC) on carcinogenesis of radiofrequency (RF, 30 kHz - 300 GHz) radiations, pages 101-102; "The reproducibility of reported effects may be influenced by exposure characteristics (including SAR or power density, duration of exposure, carrier frequency, type of modulation, polarization, continuous versus intermittent exposures, pulsed-field variables, and background electromagnetic environment), biological parameters (including

[13] Ting Wu et al., "Safe for Generations to Come," *IEEE Microw Mag* 16, no. 2 (March 2015): 65‑84.
[14] Michael Repacholi et al., "Scientific Basis for the Soviet and Russian Radiofrequency Standards for the General Public," *Bio Electro Magnetics* 33 no. 8 (December 2012): 623-633.
[15] Huai Chiang, "Rationale for Setting EMF Exposure Standards," accessed July 8, 2020.
[16] Expert Committee, Ministry of Environment and Forest, Government of India, "Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees," constituted August 30, 2010. Link to advisory
[17] S. Sivani et al., "Impacts of Radio-Frequency Electromagnetic Field (RF-EMF) from Cell Phone Towers and Wireless Devices on Biosystem and Ecosystem – A Review," *Biology and Medicine* 4, no.4 (January 2013): 202-216.
[18] "Reported Biological Effects from Radiofrequency Radiation at Low-Intensity Exposure(Cell Tower, Wi-Fi, Wireless Laptop and 'Smart' Meter RF Intensities)," The Bioinitiative Report.

cell type, growth phase, cell density, sex, and age) and environmental conditions (including culture medium, aeration, and antioxidant levels)."[19]

Until adequate exposure limits and measurement metrics are developed based on biological effects, the recommended course of action is to decrease environmental exposure as much as possible and support wired technology in order to decrease the need for additional wireless infrastructure. The public needs to be educated so they know how to reduce exposure. Companies should market 100% wired devices and peripherals and promote in-building networks that use cables/cords/ethernet to connect instead of Wi-Fi, Bluetooth and wireless[20]. The densification of wireless networks should be halted.

ICNIRP and FCC exposure limits were not designed to protect wildlife, plants or trees. As part of this letter, we are also submitting to you the July 8, 2020 letter to EHT Director Theodora Scarato from the Environmental Protection Agency's Director of the Radiation Protection Division and Office of Radiation and Indoor Air, Lee Ann B. Veal, that confirms that the EPA has never reviewed the impact of microwave radiation on birds, bees, or trees. Nor has any U.S. federal health agency ever set safety limits for trees, birds, or bees or the physical environment. No agency in the United States nor internationally has a funded mandate to ensure flora and fauna are safe from cell tower radiation. In other words, it is a gaping hole in federal accountability worldwide.

The U.S. Department of the Interior sent a letter in 2014[21] reviewing several research studies showing harm to birds and concluding 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."

A now-retired U.S. Fish and Wildlife Service wildlife biologist, the former lead on telecommunications impacts, Dr. Albert Manville, has written to the FCC on impacts to birds and on higher frequencies to be used in 5G. Dr. Manville authored numerous publications detailing research showing harm to birds.[22,23,24] "The race to implement 5G and the push by FCC to approve the related 5G license frequencies to industry are very troubling and downright dangerous."

Scientists have not developed a safety standard that stipulates a "safe level."

A Sampling of Documented Impacts to Wildlife and the Environment

- "A review of the ecological effects of RF-EMF" reviewed 113 studies finding RF-EMF had a significant effect on birds, insects, vertebrates, other organisms, and plants in 70% of the studies (Cucurachi 2013). Development and reproduction in birds and insects were the most strongly

[19] *Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields*, (IARC Press).
[20] Frank M. Clegg et al., "Building science and radiofrequency Radiation:What makes smart and healthy buildings," *Building and Environment* 176 (June 2020).
[21] Willie R. Taylor to Eli Veenendaal, Department of Interior Letter, *United States Department of the Interior OFFICE OF THE SECRETARY*, February 7, 2014.
[22] Albert M. Manville, ECFS Filing Detail, accessed July 8, 2020.
[23] Albert M. Manville, "Memorandum on the Bird and Wildlife Impacts of Non-ionizing Radiation," Environmental Health Trust, accessed July 8, 2020.
[24] Albert M. Manville, "Bird Strikes and Electrocutions at Power Lines, Communication Towers, and Wind Turbines: State of the Art and State of the Science-Next Steps Toward Mitigation," 2002.

affected. As an example of the several studies on wildlife impacts, a study focusing on RF from antennas found increased sperm abnormalities in mice exposed to RF from GSM antennas (Otitoloju 2010).

- "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz" published in Scientific Reports is the first study to investigate how insects (including the Western honeybee) absorb the higher frequencies (2 GHz to 120 GHz) to be used in the 4G/5G rollout. The scientific simulations showed increases in absorbed power between 3% to 370% when the insects were exposed to the frequencies. Researchers concluded, "This could lead to changes in insect behaviour, physiology, and morphology over time…."
- A research review on insects "Biological effects of electromagnetic fields on insects by Alain Thill" found 72 of 83 peer reviewed published studies found effects.
- Studies on bees have found behavioral effects (Kumar 2011, Favre 2011), disrupted navigation (Goldsworthy 2009, Sainudeen 2011, Kimmel et al. 2007), decreasing egg laying rate (Sharma and Kumar, 2010), and reduced colony strength (Sharma and Kumar, 2010, Harst et al. 2006).
- Research has also found a high level of damage to trees from cell antenna radiation. For example, a field monitoring study spanning nine years involving over 100 trees (Waldmann-Selsam 2016) found trees sustained more damage on the side of the tree facing the antenna.
- A study on Aspen trees near Lyons, Colorado entitled "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings" published in the *International Journal of Forestry* found adverse effects on growth rate and fall anthocyanin production, concluding that "results of this preliminary experiment indicate that the RF background may be adversely affecting leaf and shoot growth and inhibiting fall production of anthocyanins associated with leaf senescence in Trembling Aspen seedlings. These effects suggest that exposure to the RF background may be an underlying factor in the recent rapid decline of Aspen populations. Further studies are underway to test this hypothesis in a more rigorous way."[25]
- An analysis of 45 peer-reviewed scientific publications (1996–2016) on changes in plants due to the non-thermal RF-EMF effects from mobile phone radiation entitled "Weak radiofrequency radiation exposure from mobile phone radiation on plants" concludes, "Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, $p < 0.001$). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mung bean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies…."[26]

Electromagnetic Fields Alter Animal and Insect Orientation

The European Scientific Committee on Health, Environmental and Emerging Risks states "The lack of clear evidence to inform the development of exposure guidelines to 5G technology leaves open the possibility of unintended biological consequences."

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[25] Katie Haggerty, "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations," *International Journal of Forestry Research* 2010 (May 2010).
[26] Malka N. Halgamuge, "Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants," *Electromagnetic Biology and Medicine* 36, no. 2 (September 2016): 213-235.

Science of the Total Environment published environmental scientist Alforso Balmori's "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation," which states, "Current evidence indicates that exposure at levels that are found in the environment (in urban areas and near base stations) may particularly alter the receptor organs to orient in the magnetic field of the earth. These results could have important implications for migratory birds and insects, especially in urban areas, but could also apply to birds and insects in natural and protected areas where there are powerful base station emitters of radio frequencies. Therefore, more research on the effects of electromagnetic radiation in nature is needed to investigate this emerging threat."[27]

Multiple research studies have documented how animals' magnetoreception can be disrupted by external electromagnetic fields, from mice[28] to cows to dogs to birds.[29] Electromagnetic exposure is especially disruptive to migratory birds.[30] Electromagnetic fields have been shown to disrupt the magnetic compass orientation used by birds to navigate.[31,32] Researchers have suggested this disruption of magnetoreception is due to cryptochrome photoreceptors that allow birds to use built-in receptors as a biological compass.

A 2017 report to UNESCO[33] by botanist Mark Broomhall details the association between increasing amounts of electromagnetic radiation from cellular antennas on the Mt. Nardi tower complex and species disappearance and exodus from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period (2000–2015). He estimates "in both volume and species that from 70 to 90% of the wildlife has become rare or has disappeared from the Nightcap National Park within a radius of the Mt. Nardi tower complex. This statement can be summarised with concrete data: 3 bat species once common have become rare or gone, 11 threatened and endangered bird species are gone, 11 migratory bird species are gone, 86 bird species are demonstrating unnatural behaviours, 66 once common bird species are now rare or gone." The Report concludes, "With these short explanations of events we can appreciate that the effects of this technology and its application on Mt. Nardi over the last fifteen years, affect not only the top of the life chain species but they are devastating the fabric of the continuity of the World Heritage, causing genetic deterioration in an insidious, massive and ever escalating scale. To truly understand what these studies reveal is to stare into the abyss."

It is very important that in considering antenna placement, there be a full environmental assessment on migratory animal patterns (from the smallest to the largest) and not simply on birds and mammals like the pronghorn but also on impacts to amphibians and insects.

Wireless Radiation is a Public Health Issue

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[27] Alfonso Balmori, "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation," *Science of The Total Environment* 518–519 (June 2015): 58-60.
[28] E. Pascal Malkemper et al., "Magnetoreception in the wood mouse (Apodemus sylvaticus): influence of weak frequency-modulated radio frequency fields," *Scientific Reports* 5, no. 9917 (April 2015).
[29] Roswitha Wiltschko et al., "Magnetoreception in birds: the effect of radio-frequency fields," *Journal of The Royal Society Interface* 12, no. 103 (Feburary 2015).
[30] Svenja Engels et al., "Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird," *Nature* 509 (May 2014): 353-356.
[31] Roswitha Wiltschko et al., "Magnetoreception in birds: the effect of radio-frequency fields," *Journal of The Royal Society Interface* 12, no. 103 (Feburary 2015).
[32] Susanne Schwarze et al., "Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (Erithacus rubecula) than Strong Narrow-Band Fields," *Frontiers in Behavioral Neuroscience* (March 2016).
[33] Mark Broomhall, "Report detailing the exodus of species from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period (2000-2015)," United Nations Scientific and Cultural Organization, 2017.

Human health effects include impaired reproduction, increased incidence of brain cancer, DNA breaks, oxidative stress, immune dysfunction, altered brain development, sleep changes, hyperactivity, and memory and cognitive problems.[34] Since the WHO/IARC classified EMF as a Group 2B Possible Carcinogen in 2011, the peer-reviewed research connecting wireless exposure to cancer is significantly stronger, and several scientists have published documentation that the weight of current peer-reviewed evidence supports the conclusion that radiofrequency radiation should be regarded as a human carcinogen.[35,36,37]

- The 10-year $30 million National Institute of Environmental Health Sciences National Toxicology Program's (NTP) "Studies of the Toxicology and Carcinogenicity of Cell Phone Radiation"[38,39] found that RFR was associated with "clear evidence" of cancer due to the increased malignant schwannomas found in RFR-exposed male rats. The brain (glioma) cancers and tumors in the adrenal glands were also considered evidence of an association with cancer. In addition, exposed animals had significantly more DNA damage, heart damage, and low birth weight.
- The Ramazzini Institute published its findings[40] that animals exposed to very low-level RFR developed the same types of cancers as reported by the NTP.
- A 2020 Yale study funded by the American Cancer Society found that cell phone use was significantly associated with thyroid cancer in people with genetic susceptibilities[41].
- Long-term research on humans who have used cell phones has found increased tumors—schwannomas and glioblastomas—the same cell type as found in the NTP and Ramazzini Institute studies. Persons who started using cell phones under age 20 had the highest risk.[42]
- A 2015 Jacobs University study (replicating a 2010 study) found that weak cell phone signals significantly promote the growth of tumors in mice and that combining a toxic chemical exposure with RF more than doubled the tumor response.[43,44]

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[34] For more information on acute health symptoms, see Martin Pall, "Microwave Frequency Electromagnetic Fields (EMFs) Produce Widespread Neuropsychiatric Effects Including Depression," *Journal of Chemical Neuroanatomy* 75, part B (September 2016): 43-51. Response of residents living in the vicinity of a cellular phone base station in France ; Electromagnetic Fields: A Hazard to Your Health?, Healthy Children.

[35] Jessica A. Adams et al., "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis," *Environment International* 70 (September 2014): 106-112.

[36] Pravin Suryakantrao Deshmukh et al., "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation," *International Journal of Toxicology* 34, no. 3 (March 2015): 284-290.

[37] Tamir S. Aldad et al., "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice," *Scientific Reports* 2, no. 312 (March 2012).

[38] "Cell Phone Radio Frequency Radiation," National Toxicology Program, accessed July 8, 2020.

[39] Virginia Guidry, "High exposure to radio frequency radiation associated with cancer in male rats," National Institute of Environmental Health Sciences, last modified November 2018.

[40] L. 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 environmental emission," *Environmental Research* 165 (August 2018): 496-503.

[41] Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut

[42] Lennart Hardell and Michael Carlberg, "Mobile phone and cordless phone use and the risk for glioma-Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009," *Pathophysiology* 22, no. 1 (March 2015): 1-13. https://www.pathophysiologyjournal.com/article/S0928-4680(14)00064-9/fulltext

[43] Alexander Lerchl et al., "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans," *Biochemical and Biophysical Research Communications* 459, no. 4 (April 2015) 585-590.

[44] Thomas Tillmann et al., "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model," *International Journal of Radiation Biology* 86, no. 7 (June 2010): 529-541.

- A study published in Electromagnetic Biology and Medicine, "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base station," compared people living close and far from cell antennas and found that people living closer to cell antennas had higher radiation levels in the homes and several significant changes in their blood predictive of cancer development."[45]
- A 2019 study of students in schools near cell towers found their higher RF exposure was associated with impacts on motor skills, memory, and attention (Meo 2019).[46] Examples of other effects linked to cell towers in research studies include neuropsychiatric problems,[47] elevated diabetes,[48] headaches,[49] sleep problems,[50] and genetic damage.[51] Such research continues to accumulate after the 2010 landmark review study on 56 studies that reported biological effects found at very low intensities of wireless radiation, including impacts on reproduction, permeability of the blood-brain barrier, behavior, cellular changes, and metabolic changes, and increases in cancer risk (Lai and Levitt 2010).[52]
- Published research has found impacts from wireless radiation exposure to reproduction and brain development in addition to a myriad of other adverse effects.[53,54,55,56] Although renowned institutions, such as the Cleveland Clinic, advise men to keep phones and wireless devices away from their reproductive organs, the public remains largely unaware.

As more and more wireless antenna sites are built, they will be upgraded over time with new antennas and soon 5G technology. 5G would use today's wireless frequencies while adding new, higher frequencies to transmit more data to (unnecessarily) connect everything to the internet, and at faster speeds. These higher frequency sub-millimeter waves are absorbed to a higher degree by the eyes and skin,[57,20,21,22] and have been shown to accelerate bacterial growth.[58] Currently accepted standards are not sophisticated enough to

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[45] Mary Zosangzuali et al., "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations," *Electromagnetic Biology and Medicine* 36, no. 1 (August 2017): 1-11.
[46] Sultan Ayoub Meo et al., "Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health," *American Journal of Men's Health* 13, no. 1 (Jaunary 2019).
[47] G. Abdel-Rassou et al., "Neurobehavioral effects among inhabitants around mobile phone base stations," *NeuroToxicology* 28, no. 2 (March 2007): 434-440.
[48] Meo SA et al., "Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus," *International Journal of Environmental Research and Public Health* 12, no. 11 (November 2015): 14519-14528.
[49] H.P. Hutter et al., "Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations," *Occupational and Environmental Medicine* 63, no. 5 (May 2006): 307–313.
[50] R. Santini et al., "Enquête sur la santé de riverains de stations relais de téléphonie mobile: I/Incidences de la distance et du sexe," *Pathologie Biologie (Paris)* 50, no. 6 (July 2002): 369-373.
[51] Gursatej Gandhi et. al., "A cross-sectional case control study on genetic damage in individuals residing in the vicinity of a mobile phone base station," *Electromagnetic Biology and Medicine* 34, no. 4 (2015): 344-354.
[52] B. Blake Levitt and Henry Lai, "Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays," *Environmental Reviews* (2010), downloaded from www.nrcresearchpress.com by 172.58.41.200 on 04/10/19
[53] Jessica A. Adams et al., "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis," *Environment International* 70 (September 2014): 106-112.
[54] Pravin Suryakantrao Deshmukh et al., "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation," *International Journal of Toxicology* 34, no. 3 (March 2015): 284-290.
[55] Tamir S. Aldad et al., "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice," *Scientific Reports* 2, no. 312 (March 2012).
[56] Osman Fikret Sonmez et al., "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field," *Brain Research* 1356 (October 2010): 95-101.
[57] Paul Ben-Ishai, "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems," lecture, 2017 Israel Institute for Advanced Studies Conference at Hebrew University, Jerusalem, Israel, January 2017. Transcript: Yuri Feldman and Paul Ben-Ishai, "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems," 2017.
[58] Cindy L. Russell, "5G Wireless Telecommunications Expansion: Public Health and Environmental Implications," Environmental Research 165 (August 2018): 484-495.

quantify the risks of cumulative exposure.[59,60]Any future applications of these technologies must consider the biological effect of cumulative exposures to these frequencies.

"5G wireless telecommunications expansion: Public health and environmental implications," is a research review published in *Environmental Research*, which documents the range of adverse effects reported in the published literature, from cancer to bacteria growth changes to DNA damage, concludes that "a moratorium on the deployment of 5G is warranted" and "the addition of this added high-frequency 5G radiation to an already complex mix of lower frequencies, will contribute to a negative public health outcome both from both physical and mental health perspectives."[61]

"Adverse Health Effects of 5G Mobile Networking Technology Under Real Life Conditions" published in Toxicology Letters concludes that 5G mobile networking technology will affect not only the skin and eyes, but will have adverse systemic effects as well. The researchers conclude that in aggregate, for the high frequency (radiofrequency-RF) part of the spectrum, currently published reviews show that RF radiation below the ICNIRP/FCC guidelines can result in: carcinogenicity (brain tumors/glioma, breast cancer, acoustic neuromas, leukemia, parotid gland tumors), genotoxicity (DNA damage, DNA repair inhibition, chromatin structure), mutagenicity, teratogenicity, neurodegenerative diseases (Alzheimer's Disease, Amyotrophic Lateral Sclerosis), neurobehavioral problems, autism, reproductive problems, pregnancy outcomes, excessive reactive oxygen species/oxidative stress, inflammation, apoptosis, blood-brain barrier disruption, pineal gland/melatonin production, sleep disturbance, headache, irritability, fatigue, concentration difficulties, depression, dizziness, tinnitus, burning and flushed skin, digestive disturbance, tremor, cardiac irregularities, adverse impacts on the neural, circulatory, immune, endocrine, and skeletal systems" and "from this perspective, RF is a highly pervasive cause of disease."

Radiofrequency radiation exposure is increasing at a rapid pace due to the proliferation of base stations.

A 2018 article published in *The Lancet Planetary Health* points to unprecedented increasing RF exposures, and the abstract concludes, "due to the exponential increase in the use of wireless personal communication devices (eg, mobile or cordless phones and WiFi or Bluetooth-enabled devices) and the infrastructure facilitating them, levels of exposure to radiofrequency electromagnetic radiation around the 1 GHz frequency band, which is mostly used for modern wireless communications, have increased from extremely low natural levels by about 1018 times…."(Bandara and Carpenter, 2018).[62]

Another key finding from Zothansiama 2017 was that homes closer to antennas had measurably higher radiation levels – adding to the documentation that antennas increase RF levels. An Australian study also

[59] Paul Ben-Ishai, "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems," lecture, 2017 Israel Institute for Advanced Studies Conference at Hebrew University, Jerusalem, Israel, January 2017. Transcript: Yuri Feldman and Paul Ben-Ishai, "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems," 2017.
[60] Itai Hayut et al., "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts," *Physical Review E* 89, no. 4 (April 2014).
[61] Cindy L. Russell, "5G Wireless Telecommunications Expansion: Public Health and Environmental Implications," Environmental Research 165 (August 2018): 484-495.
[62] Priyanka Bandara and David O. Carpenter, "Planetary electromagnetic pollution: it is time to assess its impact," *The Lancet Planetary Health* 2, no. 12 (December 2018): 512-514.

found that children in kindergartens with nearby antenna installations had nearly three-and-a-half times higher RF exposures than children with installations further away (more than 300 meters) (Bhatt 2016).[63]

A 2018 multi-country study that measured RF levels in several countries found that cell phone tower radiation is the dominant contributor to RF exposure in most outdoor areas. Exposure levels in urban areas were higher and had drastically increased. As an example, the measurements the researchers took in Los Angeles, USA were 70 times higher than the US EPA estimate 40 years ago.[64]

5G and 4G Densification Will increase Radiofrequency Radiation

A 2020 paper "Radiation Analysis in a Gradual 5G Network Deployment Strategy," documents how engineers found significant increases in levels of radio frequency radiation that would result if a mmWave-based 5G network were fully deployed. The researchers first mapped the pre-existing LTE antennas and then laid out the real-world design for the densification of cell towers and signal repeaters which would be needed in the City in order to fully build out a mmWave-based 5G network. The engineers found the fully deployed 5G mmWave network would result in significant increases in outdoor RF levels and conclude, "This suggests that 5G mobile networks cannot yet be classified as safe for the public, and demands serious considerations before using mmWave communications for 5G networks, given the potential harms it could afflict on the public."

A 2018 study published in Annals of Telecommunications found increased RF-EMF exposure from small cell LTE networks in two urban cities in France and the Netherlands. Researchers measured the RF-EMF from LTE (Long-Term Evolution), MC (macro cells meaning large cell towers), and SC networks (low-powered small cell base stations) and found that the small cell networks increased the radio emissions from base stations (called downlink) by a factor of 7–46 while decreasing the radio emissions from user equipment exposure (called uplink) by a factor of 5–17. So, while the devices themselves could emit less radiation, the cell antennas will increase the ambient environmental levels (Mazloum et al., 2019).

Telecommunications Companies Warn Their Shareholders but Not Consumers or People Living Near Their Antennas

A number of corporations already advise their shareholders that they could face serious financial risks from the health damages due to RF. For instance, Crown Castle's 2019 10-K ANNUAL REPORT states:

> 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

[63] Chhavi Raj Bhatt et al., "Radiofrequency-electromagnetic field exposures in kindergarten children," *Journal Of Exposure Science And Environmental Epidemiology* 27, no. 5 (September 2017): 497-504.
[64] Sanjay Sagar et al., "Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context," *Environment International* 114 (May 2018): 297-306.

> will not arise in the future or that the results of such studies will not be adverse to us. 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.

Most wireless companies, from AT&T to Nokia to T-Mobile to Verizon Wireless, have issued similar warnings to their shareholders. Why are shareholders being warned but not the people living near the equipment? These disclosures show that even corporations cannot assure safety.

Insurance Companies Classify 5G as High Risk

For years, the insurance industry has ranked[65] the risk of non-ionizing radiation as "High" and has excluded coverage for damage as the industry standard in commercial policies[66]. In the United States insurance companies do not cover cell phone manufacturers and wireless infrastructure providers.

In 2019, the insurance authority Swiss Re released a white paper classifying 5G as a "high" emerging risk. "To allow for a functional network coverage and increased capacity overall, more antennas will be needed, including acceptance of higher levels of electromagnetic radiation." The report cautions that "potential claims for health impairments may come with a long latency."

Due to these evaluations and the published scientific evidence, cell phone manufacturers cannot insure against health damages from the radiofrequency radiation emitted by their products and networks. In fact, most insurance plans do not cover electromagnetic fields (EMF) and have very clear "electromagnetic field exclusions."

Wireless Companies Define Non-Ionizing Radiation as a Pollutant

Both AT&T Mobile Insurance (pg. 4) and Verizon Total Mobile Protection (page 10) state that their coverage is excluded for pollutants.

"Pollutants" are defined as "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 non-ionizing radiation and waste."

If insurance companies will not insure EMF, and if even telecommunications companies consider EMF as a "pollutant," how can governments allow such an environmental pollutant, moreover without even warning their citizens?

5G Will Increase RF Exposures to the Environment, and 5G Antenna Beamforming Exposures Cannot Be Accurately Measured

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[65] "Insurance Authorities Rate 5G and Electromagnetic Radiation as 'High Risk,'" Environmental Health Trust, accessed July 8, 2020.
[66] "Electromagnetic Field Insurance Policy Exclusion Are The Standard," Environmental Health Trust, accessed July 8, 2020.

Studies on small cell deployment show increased environmental exposures from the densification of cellular antennas[67]. Engineers simulating a 5G network for Austin Texas also found significant increases for a fully deployed millimeter wave[68]. A 2018 multi-country study published in *Environment International* found that cell phone tower radiation is the dominant contributor to RF exposure in most outdoor areas and environmental exposure has significantly increased over the last four decades[69].

A 2019 European Parliament Report "5G Deployment: State of Play in Europe, USA, and Asia"[70] confirms increased exposure from the 5G/4G Densification, stating, "increased exposure may result not only from the use of much higher frequencies in 5G but also from the potential for the aggregation of different signals, their dynamic nature, and the complex interference effects that may result, especially in dense urban areas." The report points out that it currently "is not possible to accurately simulate or measure 5G emissions in the real world," stating,

> The 5G radio emission fields are quite different to those of previous generations because of their complex beamformed transmissions in both directions – from base station to handset and for the return. Although fields are highly focused by beams, they vary rapidly with time and movement and so are unpredictable, as the signal levels and patterns interact as a closed loop system. This has yet to be mapped reliably for real situations, outside the laboratory.

5G Will Increase Energy Consumption

Since 5G networks are being built in addition to existing cellular networks, the energy consumption of cellular and wireless device networks and infrastructure as a whole will increase. This reality has been repeatedly documented in industry reports and research publications[71][72][73]. A 2020 Report by the High Council for Climate found that 5G technology could add between 2.7 to 6.7 million tonnes of CO2 equivalents per year by 2030[74]. Because more 5G base stations are needed to cover the same area, there will be millions of new base stations worldwide as well as billions of new interconnected devices, all contributing to increased overall energy consumption. Gains in energy efficiency will be swamped by the sheer number of new devices [75][76].

"A typical 5G base station consumes up to twice or more the power of a 4G base station. The disparity can grow at higher frequencies, due to a need for more antennas and a denser layer of

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[67] Taghrid Mazloum et al., "RF-EMF exposure induced by mobile phones operating in LTE small cells in two different urban cities," *Annals of Telecommunications* 74 (November 2018): 35-42.
[68] Ahmad M. El-Hajj and Tarek Naous. "Radiation Analysis in a Gradual 5G Network Deployment Strategy," in *2020 IEEE 3rd 5G World Forum (5GWF)* (Bangalore, India: IEEE, 2020), 448-453.
[69] Sanjay Sagar et al., "Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context," *Environment International* 114 (May 2018): 297-306.
[70] Colin Blackman and Simon Forge, "5G Deployment State of Play in Europe, USA and Asia," European Parliament's Committee on Industry, Research and Energy, accessed February 24, 2020.
[71] Mark P. Mills, "The Cloud Begins with Coal – Big Data, Big Networks, Big Infrastructure, and Big Power. An overview of the electricity used by the global digital ecosystem," National Mining Association and American Coalition for Clean Coal Electricity, August 2013.
[72] Anders S.G. Andrae and Tomas Edler, "On Global Electricity Usage of Communication Technology: Trends to 2030," *Challenges* 6, no. 1 (April 2015): 117-157.
[73] "Controlling the carbon impact of 5G," High Council for the Climate Report, December 2020.
[74] "French study finds 5G increases risk to climate," The Connexion, last modified December 19, 2020.
[75] Linda Hardesty, "5G base stations use a lot more energy than 4G base stations: MTN," Fierce Wireless, last modified April 3, 2020.
[76] Matt Walker, "Operators facing power cost crunch," MTN Consulting, March 27, 2020.

small cells. Edge compute facilities needed to support local processing and new Internet of things (IoT) services add to overall network power usage."- Matt Walker Operators facing power cost crunch MNT Consulting

The Shift Project Report[77], "LEAN ICT: TOWARDS DIGITAL SOBRIETY": OUR NEW REPORT ON THE ENVIRONMENTAL IMPACT OF ICT" documented the increased energy consumption and concludes that "the current trend for digital overconsumption in the world is not sustainable with respect to the supply of energy and materials it requires...The digital transition as it is currently implemented participates to global warming more than it helps preventing it. The need for action is therefore urgent."

5G and the Internet of Things Is Increasing E-Waste

In 2019 the Global E-waste Monitor documented that a record 53.6 million metric tonnes (Mt) of e-waste was generated by discarded digital products, up 9.2 Mt in five years. The report predicts global e-waste will reach 74 Mt by 2030, almost double from 2014[78].

Wired Technology is Safer for Humans and Wildlife

Access to information is indisputably critical for the modern world. But, contrary to what some in the telecommunications world argue, this access need not be wireless. Wired technologies such as fiber or coaxial cable are far superior to wireless as they are faster, more reliable, resilient, energy-efficient, and more easily defended from cyber-attacks. Above all, wired connections are significantly less hazardous to our health and to other life forms with whom we share this planet.

Worldwide Action to Halt 5G

Over 600 cities in Italy have passed resolutions to halt 5G, as have numerous cities throughout Europe, such as Trafford, United Kingdom; Lille, France; Ormidia, Cyprus; and Balchik, Bulgaria. The Pancyprian Medical Association and Cyprus National Committee on the Environment and Child Health sent Parliament their position paper, "The Risks to Public Health from the Use of the 5G Network." Bermuda has halted 5G pending an investigation into health and safety and we recently testified to the regulatory authority along with several other experts[79].

Switzerland's report on 5G health effects resulted in the Parliament's refusal to loosen their radiation limits despite heavy industry lobbying efforts. The Netherlands issued a 5G report that recommended measuring radiation levels and also advised against using the 26 GHz frequency band for 5G "for as long as the potential health risks have not been investigated."

[77] "Lean ICT: Towards Digital Sobriety: Our New Report on the Environmental Impact of ICT," The Shift Project, March 6, 2019.
[78] "Global E-waste-Monitor 2020," ITU, last accessed December 30, 2020.
[79] "5G Health Effects Testimony to Bermuda Regulatory Authority," Environmental Health Trust, last modified December 3, 2020.

In the United States, the New Hampshire Commission to Study the Environmental and Health Effects of Evolving 5G Technology has released its final report with 15 recommendations to reduce public exposure to radio frequency radiation, ensure setbacks so that cell antennas are at a distance from homes and schools, protect children by reducing wireless exposures and prioritizing safer wired connections, designate wireless free areas and create federal regulations for exposure that protect wildlife and the environment.

In the United States, resolutions to halt 5G have been passed by Hawaii County, Farragut Tennessee, Coconut Creek Florida, and Easton Connecticut. US cities such as Los Altos, Petaluma, Mill Valley, and San Diego County California have adopted policies to restrict 5G small cells near homes. Oregon passed a Bill to study Wi-Fi health effects with a final report due in 2021.

The increased exposures of 5G are involuntary. We can turn off our phones, but we cannot turn off the antennas in the neighborhood. The birds, bees, and trees also have no choice.

Thank you for your consideration of this issue. We would be happy to set up a meeting to discuss this issue further.

Sincerely,

Devra Davis, PhD, MPH
Fellow, American College of Epidemiology
Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayis Univ. Medical School
Associate Editor, Frontiers in Radiation and Health
President, Environmental Health Trust

Theodora Scarato
Executive Director, Environmental Health Trust

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Letter from the EPA

--------- Forwarded message ---------
From: **Veal, Lee**<Veal.Lee@epa.gov>
Date: Wed, Jul 8, 2020 at 11:32 AM
Subject: RE: Letter with specific Questions Related to the FDA review and to the EPA, CDC, NIOSH and FDA Jurisdiction on EMFs
To: Theodora Scarato <Theodora.Scarato@ehtrust.org>

Dear Director Scarato;

Thank you for sending us your questions and references regarding radiofrequency (RF) radiation. Up through the mid-1990s, EPA did study non-ionizing radiation. The Telecommunications Act of 1996 directs the Federal Communications Commission (FCC) to establish rules regarding RF exposure, while the U.S. Food and Drug Administration (FDA) sets standards for electronic devices that emit non-ionizing or ionizing radiation. EPA does not have a funded mandate for radiofrequency matters, nor do we have a dedicated subject matter expert in radiofrequency exposure. The EPA defers to other agencies possessing a defined role regarding RF. Although your questions are outside our current area of responsibilities, we have provided a response to each one as you requested.

1. *What is your response to these scientists' statements regarding the FDA report and the call to retract it?*

   EPA Response: The EPA does not have a funded mandate for radiofrequency matters, has not conducted a review of the FDA report you cited or the scientists' statements, and therefore has no response to it.

2. *To the FDA- What consultants were hired for the FDA review and report on cell phone radiation?*

   EPA Response: This is not an EPA matter. Please refer this question to the FDA.

3. *What US agency has reviewed the research on cell phone radiation and brain damage? I ask this because the FDA only has looked at selected studies on cancer. If your agency has not, please simply state you have not.*

   EPA Response: EPA's last review was in the 1984 document Biological Effects of Radiofrequency Radiation (EPA 600/8-83-026F). The EPA does not currently have a funded mandate for radiofrequency matters.

4. What US agency has reviewed the research on damage to memory by cell phone radiation? If so, when and send a link to the review.

   EPA Response: EPA's last review was in the 1984 document Biological Effects of Radiofrequency Radiation (EPA 600/8-83-026F). The EPA does not currently have a funded mandate for radiofrequency matters.

5. *What US agency has reviewed the research on damage to trees from cell phone radiation? If so, when was it issued and send a link to the review.Note this study showing damage from long term exposure to cell antennas.*

   EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it.

6. *What US agency has reviewed the research on impacts to birds and bees? If so, when and send a link to the review. I will note the latest research showing possible impacts to bees from higher frequencies to be used in 5G.*

   EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it.