

Regarding the Independent Commission to Study the Effects of 5G and Other Non ionizing Radio Frequency Radiation-emitting technology.

I have been asked by CTIA, the wireless industry trade association, to address the proposed commission. **I am opposed to establishing the proposed commission simply because the work has already been done before and a larger commission is being established as we speak in the United States.**

I am an IEEE member, an American Board of Health Physics certified health physicist and public health professional with over 30 years of experience in evaluating both ionizing and non-ionizing radiation exposures and health effects. My master's degree is in health physics, I was a panel chairman for certification of health physicists nationally, was the radiofrequency expert for the State of Washington for an 18-year period, am an editor of the Health Physics Journal for non-ionizing radiation topics, was a consultant of the ACGIH Threshold Limit Values for Physical Agents Committee and was an Adjunct Professor of Health Physics at Vanderbilt University from 2004 to 2014. I have performed thousands of site evaluations and have given over 1,500 presentations on a variety of health and exposure related topics to a wide range of audiences over the past 30 years.

To a degree, 5G uses the same frequencies as current wireless communication. These radiofrequency (RF) waves given off by the antennas used are the same as those used by FM radio and TV. 5G can also use mm Waves, which are relatively new for cellular applications but have been used in airport scanners, auto collision avoidance systems and perimeter surveillance radar systems. The RF energy from existing and 5G mmWave frequency bands is non ionizing and is fundamentally different than ionizing radiation associated with X-ray machines, CAT scans and nuclear power. The RF energy used in wireless communication is over 100,000 times too low to directly break chemical bonds or disrupt macromolecules such as DNA. In fact our standards are based upon heat loading because, for the past 70+ years of research that is the only reproducible effect that has been shown

The established limits are based on known biological effects and are primarily related to tissue heating. For the general public, the allowable whole body exposure limit is based on a specific absorption rate of 0.08 W/kg, which is at least 50 times lower than the lowest observable effects for behavioral disruption. Measurements in the field are performed to ensure that the specific absorption rate is not exceeded which for higher frequencies is 1 mW/cm².

Approximately 60 countries use the guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP recently reaffirmed their guidelines, which are almost identical to the U.S. limits, in 2020. Approximately 14 countries have

standards that are lower than the ICNIRP/IEEE standard. These lower standards are not health-based standards but based on the concept of prudent avoidance.

The lower and mid frequency 5G bands are in the 600 MHz, 800 MHz, 2500 MHz, 3500 MHz and 5500 MHz range. These bands are used in existing WiFi networks, UHF TV bands (previously) and existing wireless networks and a tremendous amount of information exists as to the safety of these bands. For frequencies less than 6 GHz, the biological effects and impact of the 5G NR would have no meaningful difference between the current 2G, 3G and 4G technologies as the penetration depths are reduced at the frequency increases and the heating mechanisms remain the same. I want to make it clear that the vast majority of the 5G bands utilize frequencies less than 6 GHz. It is only in dense urban environments that the mm Wave frequencies are used, which might not be very common in the great State of Maine. At the higher frequencies above 6 GHz the mm Wave 5G bands currently include frequencies up to 39 GHz. At these frequencies the energy is absorbed within the outer layer of the skin where surface heating is the predominant effect. At these higher 5G frequencies, the existing standards are set to prevent excessive heating at the surface of the skin and the eye. Provided the exposures remain less than the limits excessive tissue heating is not a concern. Further, concerns about skin cancer or similar effects from mmWave exposure are ill founded as radio waves are at least 100,000 times less energetic than the UV light energies that possess the minimum energy for genetic damage.

Regarding the power levels used for the 5G mm Wave antennas, they are significantly less than the 3G and 4G frequency bands. Most mm Wave antennas use about 0.1 Watt input power. This is due in part to the active beam forming nature of the technology requiring a lower power to achieve the same result, a shorter distance travelled, with the net result a significantly lower exposure to individuals who are not users. In terms of overall exposure, the 5G mmWave contribution is a small fraction of the total from other sources and in most instances the uplink frequency from a personal phone will remain the greatest exposure. As mentioned, these mm Wave frequencies do not penetrate the outer layer of the skin and as such it would be very difficult to result in the adverse health outcomes that are of concern to people. Provided the exposures remain below the established and recently updated guidelines of the United States and the International Commission of Non Ionizing Radiation Protection (ICNIRP) the research to date provides no indication of adverse health effects from the mm Wave exposures. Again, it is acknowledged that the research on the biological effects of mm Wave is more limiting than that of the lower frequency bands but there is nothing to suggest that exposures less than the current limits are harmful and this point is made by every single governmental review organization in the western world. In terms of perspective, there was a huge outcry during the day when microwaves ovens were introduced and a similar concern in the 90s and 2000s when the 2G, 3G

and 4G wireless phones were introduced. Neither was shown to be true. The same can be expected with the 5G mm Wave technology.

To better inform setting of the RF-EMF guidelines the World Health Organization prioritized a comprehensive review of health outcomes evaluated by experts in the various fields of study. This large compendium was published in the journal *Environment International* in 2024. It covers everything from cancer, acute effects, fertility, behavioral effects and many other endpoints although not specific to children's exposure.

Since 2010 there have been over 100 expert reviews completed¹. While not specifically limited to 5G or the effects on children, plants or animals, the reviews are inclusive of those endpoints. The expert reviews have been sponsored by

- The World Health Organization (WHO),
- The European Union Scientific Committee on Health, Environment and Emerging Risks (SCHEER),
- The Spanish Scientific Advisory Committee on Radiofrequency and Health,
- The Dutch and United Kingdom Cohort Study on Mobile Phone Use and Health,
- The International Agency for Research on Cancer (IARC),
- The Swedish Radiation Safety Authority (annually),
- The Australian Radiation Protection and Nuclear Safety Agency,
- The Austrian Scientific Council for Radio Communications,
- The American Cancer Society,
- The Health Council of the Netherlands,
- The International Commission on Non Ionizing Radiation Protection,
- The US Food and Drug Administration,
- The US National Cancer Institute,
- Health Canada,
- The New Zealand Ministry of Health,
- The United States Center for Disease Control,
- The Nordic Radiation Safety Authorities,
- The Swiss Federal Office of the Environment,
- The IEEE Committee on Man and Radiation,
- The French Agency for Food, Environment, Occupational Health and Safety,
- The UK Independent Advisory Group on Non Ionizing Radiation,
- The Ontario Agency for Health Protection and Promotion,

¹ <https://www.ices-emfsafety.org/publications/expert-reviews/>. Accessed March 19, 2025.

- The Latin American Scientific Review Committee

Further, reviews and studies specific to children and adolescents do exist, although not in as great a number. A number of studies/reviews have been performed in recent years where the primary focus of the study or review was children's health and radiofrequency exposure. To name a few:

- Food and Drug Administration, 2020²
- Mobi Kid's study. A 14 country study investigating childhood brain cancer and RF exposure (2022)³
- A literature review by Ishihara⁴ et al studying radiofrequency exposure and cognitive function in children and adolescents (2020).
- A study on maternal cell phone use and a child's language, communication and motor skills (2017)⁵
- A study on mobile phone use and sleep problems in children (2015)⁶
- The Health Effects Related to Mobile Phone Use in Adolescents (HERMES I 2015)⁷
- The Health Effects Related to Mobile Phone Use in Adolescents (HERMES II 2018)⁸
- A study on radiofrequency field exposures in kindergarten children (2017)⁹
- A Systematic review of the physiological and health-related effects of radiofrequency electromagnetic field exposure from wireless communication devices on children and adolescents in experimental and epidemiological human studies (2017)¹⁰

² <https://www.fda.gov/media/135043/download>. Accessed 03/20/2025.

³ <https://researchportal.ukhsa.gov.uk/en/publications/wireless-phone-use-in-childhood-and-adolescence-and-neuroepitheli>. Accessed 03/20/2025. Only the UK study linked here, other countries results are available on line.

⁴ Ishihara T, Yamazaki K, Araki A, Teraoka Y, Tamura N, Hikage T, Omiya M, Mizuta M, Kishi R. Exposure to Radiofrequency Electromagnetic Field in the High-Frequency Band and Cognitive Function in Children and Adolescents: A Literature Review. *Int J Environ Res Public Health*. 2020 Dec 8;17(24):9179. doi: 10.3390/ijerph17249179. PMID: 33302600; PMCID: PMC7764655. Accessed 03/20/2025

⁵ Papadopoulou, E., Haugen, M., Schjølberg, S. *et al*. Maternal cell phone use in early pregnancy and child's language, communication and motor skills at 3 and 5 years: the Norwegian mother and child cohort study (MoBa). *BMC Public Health* 17, 685 (2017). <https://doi.org/10.1186/s12889-017-4672-2>

⁶ Huss A, van Eijsden M, Guxens M, Beekhuizen J, van Strien R, Kromhout H, Vrijkotte T, Vermeulen R. Environmental Radiofrequency Electromagnetic Fields Exposure at Home, Mobile and Cordless Phone Use, and Sleep Problems in 7-Year-Old Children. *PLoS One*. 2015 Oct 28;10(10):e0139869. doi: 10.1371/journal.pone.0139869. PMID: 26509676; PMCID: PMC4625083.

⁷ Anna Schoeni, Katharina Roser, Martin Rösli, Memory performance, wireless communication and exposure to radiofrequency electromagnetic fields: A prospective cohort study in adolescents, *Environment International*, Volume 85, 2015,

⁸ <https://ehp.niehs.nih.gov/doi/10.1289/EHP2427>.

⁹ Bhatt CR, Redmayne M, Billah B, Abramson MJ, Benke G. Radiofrequency-electromagnetic field exposures in kindergarten children. *J Expo Sci Environ Epidemiol*. 2017 Sep;27(5):497-504. doi: 10.1038/jes.2016.55. Epub 2016 Oct 19. PMID: 27759027.

¹⁰ Bodewein L, Dechent D, Graefrath D, Kraus T, Krause T, Driessen S. Systematic review of the physiological and health-related effects of radiofrequency electromagnetic field exposure from wireless communication devices on children and adolescents in experimental and epidemiological human studies. *PLoS One*. 2022 Jun 1;17(6):e0268641. doi: 10.1371/journal.pone.0268641. PMID: 35648738; PMCID: PMC9159629.

- A review on radiofrequency exposure in children and their impacts on health (2023)¹¹
- There are also a number of forthcoming studies related to radiofrequency exposure and children, the largest of which is GOLIAT (5G expOsure, causaL effects, and rIsk perception through citizen engAgement)¹², which is a five-year project aimed at providing responses to some of the questions raised by the new wireless technologies, with a special focus in 5G. This specific project was initiated in 2022 and is currently scheduled for completion in 2027.

The establishment of a commission in Maine does appear to be overcome by events as the White House has recently established a Make American Healthy Again Commission and in section 4 (a) the commission shall study the scope of childhood chronic disease which includes electromagnetic radiation as possible environmental factors.

Finally, regarding the potential impact to birds, bees and other wildlife. Perhaps one of the most widely cited memos regarding impacts to birds and wildlife is from Dr. Manville, formerly of the US Fish and Wildlife Service¹³. Ten to fifteen years ago there was a belief that the “colony collapse disorder” affecting the bee population might be caused by exposure to RF sources. A few (poorly performed) papers even studied the effects by using a cell phone near a bee hive and observing the effects. Recent evidence has shown that the population is recovering and that a number of sources potentially affecting the bee population have been identified, none of which are radiofrequency or EMF sources¹⁴. A number of studies have been able to identify effects from ELF (60 Hz) exposures. These exposures are greater than 10 Gauss and significantly higher than any exposure that can be found in our environment to include any transmission line source. But even at these high exposures the effects are limited to the ability to “sense” the external magnetic field and nothing more and certainly not an adverse health effect.

Some studies have shown that at certain frequencies the oscillating magnetic field of an RF signal can disrupt the birds sensing of the earth's magnetic field. 1.2 MHz and 2.4 MHz seem to be those frequencies with a threshold effect of 12 nT. Again here, these are not the frequencies of cellular phones so this study, even if there were verified and validated, they are not applicable.

¹¹ Hyungryul Lim, Jonghyuk Choi, Hyunjo Joo, Mina Ha, Exposures to radio-frequency electromagnetic fields and their impacts on children's health – What the science knows?, Current Opinion in Environmental Science & Health, Volume 32, 2023, 100456, ISSN 2468-5844, <https://doi.org/10.1016/j.coesh.2023.100456>.

¹² <https://projectgoliat.eu/about/>

¹³ Manville, A.M. A briefing memorandum: What we know, can infer, and don't yet know about impacts from thermal and non thermal non-ionizing radiation to birds and other wildlife. July 14, 2016.

¹⁴ <https://www.epa.gov/pollinator-protection/colony-collapse-disorder> Access 03/21/2025.

A review by Curcurachi¹⁵ in 2013 looked at the published ecological effects of RF exposure on birds. In general, an absence of effects were found when power densities for exposure were less than those required for tissue heating (hyperthermia). However, Curcurachi included a number of papers where the dosimetry was lacking and including the positive effects of those studies in the results is not justified. Examples of those studies include Bastide (2001) and Batellier (2008). Insufficient information could be obtained from a Russian study (Grigoryev 2003) to make comment. Field studies were included in the review of papers such as Balmori (2005) and Reijt (2007) are little more than observational studies. Balmori attributed effects on power density differences of $1 \mu\text{W}/\text{cm}^2$ to $0.07 \mu\text{W}/\text{cm}^2$. The lack of control for other variables limits the value of such a study given the very low power density values precluding any thermally related effects.

A systematic literature search was performed by the Health Council of the Netherlands¹⁶ revealed a substantial body of 54 animal studies on the carcinogenesis of exposure to RF fields. In 23 studies the effect of exposure to RF EMF alone has been investigated. A variety of animal models and tumor types has been used, as well as a number of different types of RF signals, although the focus has been on the types of signals used in modern mobile telecommunication. Exposure has been from several weeks up to two years, and the follow-up time generally life-long. In addition, 24 studies investigated the modulating effects of RF exposure on carcinogenesis induced by various well-known carcinogenic compounds, and another seven studies on the effect of RF exposure on the growth of implanted tumours. These data cover a wide range of experimental situations and may thus provide a reasonable insight into the effects of RF exposure on carcinogenesis in rodents.

In 2019 a workshop was convened in Germany that discussed the biological effects of radiofrequency exposure on flora and fauna¹⁷. The conclusion then and now is that the the only scientifically established action mechanism in organisms is the conversion of electromagnetic into thermal energy. In accordance with that, no proven scientific evidence of adverse effects in animals or plants under realistic environmental conditions has yet been identified from exposure to low-level anthropogenic radiofrequency fields in this frequency range. The report does acknowledge that further research is recommended.

¹⁵ Curcurachi, A. et al. A Review of the ecological effects of radiofrequency electromagnetic fields. *Environment International*. 51 (2013). 116-140.

¹⁶ <https://www.healthcouncil.nl/documents/advisory-reports/2014/09/05/mobile-phones-and-cancer-part-2-animal-studies-on-carcinogenesis> Accessed 03/20/2025.

¹⁷ <https://pmc.ncbi.nlm.nih.gov/articles/PMC9722376/pdf/hpj-124-31.pdf> Accessed 03/21/2025.

To summarize, there exists a large amount of data for the health endpoints of interest. The existing data does not give rise or indicate possible negative health outcomes from exposure less than the public exposure limits nor are there any established biophysical mechanisms by which harm could occur at exposures under the allowable public limits. Independent expert review panels are convened every year and they are sponsored by either countries, groups of countries and or large international non governmental organizations. A small commission hosted by a state with a limited number of experts in each area of study will be limited to the background and inherent bias of a single individual for a given area of expertise. Larger national reviews are generally able to avoid those budgetary constraints.

Regards,



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