

September 08, 2017

The Honorable Jerry Brown
Governor, State of California
c/o State Capitol, Suite 1173
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities

Honorable Governor Brown,

I have recently learned of proposed Bill SB 649 regarding the streamlining of small cell wireless facilities.

As a member of the Physics department of Ariel University, and before that the Hebrew University of Jerusalem, I have studied the subtle effects of electromagnetic radiation on biology and biological materials. I have published more than 50 articles in the field of Dielectrics (the study of the interaction of materials with radio waves), including many on the interaction of cellular frequencies with biological materials such as proteins and blood. My last article investigated the interaction of 5G electromagnetic radiation with human skin.¹ One could argue that I have a certain amount of expertise.

In light of our work and a growing number of publications showing the frequency range of 5G can have serious biological effects, we believe that current efforts to accelerate the implementation of 5G should be delayed until additional studies are made to assess the critical impact on human health.

It is not for me to lecture to elected officials on how cities should develop technologically, nor is it for me to try and stop the juggernaut that is the cellular industry. However, I would like to point out to you important information on the possible public health implications of the explosion in unregulated cellular phone and wireless device use.

The term “health” has never featured too heavily in the lexicon of the Cellular Industry. It has been assumed, conveniently, that any possible effects on the human anatomy from the use of cell phones would be only mild heating. And that this is something that the body could easily deal with. As a consequence, the governing safety limits were set in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) based on the premise that if radiofrequency radiation limits protected human tissue from overheating, then the public was adequately protected. They considered that the effect to humans would at most cause the agitation of water inside cellular tissues that would dissipate as heat, similar to what a microwave oven does, but at far lower energies.

The trouble is that our knowledge has progressed in the last 19 years and we now understand that the interaction of microwave energy and our tissues is far more subtle. There is increasing evidence of non-thermal biological consequences arising from our interaction with cellular phone radiation. A few examples; in 2014 a team from the University of Exeter, UK published a report linking the effect of

¹ Betzalel, Noa, Yuri Feldman and Paul Ben Ishai. “The Modeling of the Absorbance of Sub-THz Radiation by Human Skin.” *IEEE Transactions on Terahertz Science and Technology* PP.99 (2017): 1-9. [doi: 10.1109/TTHZ.2017.2736345](https://doi.org/10.1109/TTHZ.2017.2736345).



cellular phones on declining sperm quality.² They based their research on over 1492 subjects from around the world. In 2009, Columbia University showed that radio frequencies were leading to stress in living cells.³ This in turn seriously affects their ability to perform, as particular cellular pathways were disrupted. Further evidence along this direction was provided by a group from the University of Rennes.⁴ I can add plenty more examples, but I think that it is summed up by a recent public announcement. Advisors to the World Health Organization International Agency for Research on Cancer (WHO/IARC), themselves well versed in radio frequencies and in cancer, have publicly stated that evidence has been met to classify cellular radiation as meeting scientific criteria for a Group 1 carcinogenic agent to humans.^{5,6}

As I said above, it is not my job and neither is it realistic for me to stop the placing of thousands of antennas throughout your state. But it is my job to point out the health hazard to you before you make such a momentous decision.

Yours sincerely



Dr. Paul Ben Ishai
Department of Physics
Ariel University

CC
Tom Dyer, Chief Deputy Legislative Affairs Secretary

² Adams, J.A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International* 70 (2014): 106-12. [doi: 10.1016/j.envint.2014.04.015](https://doi.org/10.1016/j.envint.2014.04.015).

³ Blank, M. and R. Goodman. "Electromagnetic fields stress living cells." *Pathophysiology* 16.2-3 (2009): 71-8. [doi: 10.1016/j.pathophys.2009.01.006](https://doi.org/10.1016/j.pathophys.2009.01.006).

⁴ Habauzit, Denis, et al. "Transcriptome analysis reveals the contribution of thermal and the specific effects in cellular response to millimeter wave exposure." *PLoS One* 9.10 (2014): e109435. [doi: 10.1371/journal.pone.0109435](https://doi.org/10.1371/journal.pone.0109435).

⁵ "Cancer Expert Declares Cell Phone and Wireless Radiation As Carcinogenic to Humans." Environmental Health Trust (2017). <https://ehtrust.org/cancer-expert-declares-cell-phone-wireless-radiation-carcinogenic-humans/>.

⁶ Carlberg, Michael and Lennart Hardell. "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation." *BioMed Research International* 2017 (2017): 9218486. [doi: 10.1155/2017/9218486](https://doi.org/10.1155/2017/9218486).

SB 649 Would Eliminate the Ability of Communities to Promote their Interests and Priorities.

It is important to remember that the rights-of-way that providers use to build out their networks are **owned by communities and managed by municipalities**.¹ Currently, if a phone or broadband provider wants access to a local community's right-of-way, it can negotiate with that community for a franchise, paying fair-market value for that access. Additionally, communities can currently negotiate with providers to advance community priorities and interests in exchange for access to community-owned rights of way. For example, if a provider seeks access to build out its network in a high-income area, a community could grant access to that in exchange for that providers' providing high-speed broadband to anchor institutions in lower-income areas. SB 649 would eliminate communities' ability to manage their rights-of-way, unduly interfering with those communities' right to self-determination.

SB 649 Would Allow Providers to Use Community-Owned Property without Paying Just Compensation.

Phone and broadband providers already reap windfall profits from Californians. SB 649 limits communities to charging set prices and fees for access to their rights-of-way. These artificial restrictions distort the market and force consumers to subsidize providers' costs. SB 649 prevents communities from getting full market value in exchange for access to rights-of-way. Accordingly, SB 649 increases the power of providers to extract profits from local communities that already face monopoly or near-monopoly prices.

Greenlining supports any legislative measure that increases the availability of advanced communications services to communities of color. Unfortunately, SB 649 is not such a measure. The bill promises to widen the digital divide, place control over community-owned property in the hands of providers, and fail to compensate communities fairly. Accordingly, Greenlining OPPOSES SB 649.

If you have any questions, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink that reads "Stephanie" followed by a long, horizontal flourish.

Stephanie Chen
Energy & Telecommunications Policy Director

¹ Frederick E. Ellrodd III & Nicholas P. Miller, Property Rights, Federalism, and Public Rights-of-Way (2003) 26 Seattle Univ. Law. Rev. 475, 477.

Alliance of Nurses for Healthy Environments



June 26, 2017

The Honorable Cecilia Aguilar-Curry,
Chair Assembly Local Gov't Commission
Room 157, 1020 N Street Sacramento,
CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities - - OPPOSE

Dear Chair Aguilar-Curry:

I am a Professor of Public Health at the University of San Francisco and a Board Member of the national Alliance of Nurses for Healthy Environments. I am very concerned about moving forward with expanding the use of small-scale wireless technologies at the same time that there is mounting evidence of the potential for health risks from the associated radio frequency energy and radiation, particularly to children. The Alliance of Nurses for Healthy Environments ascribes to the precautionary principle as it applies to human health. We firmly believe that early warnings in the scientific literature should be heeded and that our policy development should reflect the synthesis of the best and latest scientific evidence.

At this point in time, we oppose SB 649 and believe that we need an exhaustive review of the science before we allow significant expansion of small cell wireless facilities, such as those to facilitate 5G networks. The results of the literature review should inform our policies. We must be sure that vulnerable populations such as pregnant women and young children will not be unduly harmed from their proximity to unnecessary radio frequency energy. It is important that we continue to examine what constitutes a safe distance and how we can continue to pivot when more information becomes available. We are concerned that the passage of SB 649 will entrench us in a policy for which we have insufficient assurances and which, if passed, will require the burden of effort to reverse.

For these reasons, we oppose SB 649 and urge a “no” vote in the Local Government Committee.

Thank you for considering our concerns.

Sincerely,

Barbara Sattler, RN, MPH, DrPH, FAAN
Board Member



August 15, 2017

The Honorable Cecilia Aguiar-Curry
Chair, Assembly Local Government Committee
State Capitol Building, Room 5144
Sacramento, CA 95814

SB 649 (Hueso)- Wireless Telecommunications Facilities- OPPOSE

Chair Aguiar-Curry,

On behalf of the undersigned, we write to register our opposition to SB 649 (Hueso) which would prohibit local discretionary review of "small cell" wireless antennas, including equipment collocated on existing structures or located on new "poles, structures, or non-pole structures," including those within the public right-of-way and buildings. The proposal preempts adopted local land use plans by mandating that "small cells" be allowed in all zones as a use by-right, including all residential zones. Because of this, this proposal essentially provides a CEQA exemption for installation of these facilities, undermining the ability for communities to comment and register their concerns associated with previously mentioned installation. These "small cell" installations not only can cause an aesthetic blight, but can release levels of radiation that we don't yet know conclusively the health impacts they can impose of humans, especially developing bodies and minds of children. These small cell boxes could pop up anywhere: grocery stores, outside school, playgrounds, communal places, with no requirement to mitigate effects or understand potential environmental and health hazards.

For these reasons, we urge your "no" vote in committee.

Thank you,

Jena Price, Legislative Affairs Manager
California League of Conservation Voters

Kyle Jones, Legislative Associate
Sierra Club California

Jane Williams, Executive Director
California Communities Against Toxics



892 Arlington Av. Berkeley, CA, 94707 (307) 200-9358
www.ehtrust.org

June 28, 2017

The Honorable Cecilia Aguiar-Curry
Chair of the Local Government Committee
1020 N Street, Room 157
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities — OPPOSE

Dear Chair Aguiar-Curry:

As a nonprofit research and policy organization dedicated to identifying and reducing environmental health hazards, Environmental Health Trust (EHT) writes to advise you of serious scientific grounds to reject SB 649 as advanced by Senator Hueso. I have personally served as an expert advisor to the California Department of Health as well as the San Francisco and Berkeley City governments on matters relevant to this bill. EHT has been honored to work with California government and scientists for over a decade. At the invitation of the Israel Institute for Advanced Study of the Hebrew University of Jerusalem, EHT recently organized and chaired an [Expert Forum on Wireless Radiation and Health](#), bringing together scientists and engineers from more than ten high tech nations. Reflecting these efforts, EHT provides independent scientific research and advice on avoidable environmental health hazards to local, state and national governments.

SB 649 will pave the way for widespread introduction of 5G microwave wireless radiation frequency (RF) that has never been tested for its impact of public health or the environment. Other RF microwave radiation such as that used by cellphones and other wireless devices has been [classified as a 'possible carcinogen'](#) by the International Agency for Research on Cancer in 2011 and more recently dubbed a ['probable carcinogen.'](#) by expert researchers looking at newer information in 2015.^{1,2,3} In addition, this bill could result in the loss of hundreds of millions of dollars in local revenue, as the [San Francisco Chronicle noted](#) today.

By ignoring growing scientific evidence of harm, the bill effectively will ensure the widespread exposures of millions of Californians to an agent that growing numbers of scientists and nations consider a serious

¹ World Health Organization. ["IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans."](#) WHO, Press Release, no. 208, 2011.

² IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. ["Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields."](#) *IARC Monographs On The Evaluation of Carcinogenic Risks to Humans*, vol. 102, pt. 2, 2013.

³ Morgan, L. Lloyd, et al. ["Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen \(2A\)."](#) *International Journal of Oncology*, vol. 46, no. 5, 2015, 1865-71.

health threat. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects⁴, as Dr. Cindy Russell, Vice President of Community Health for the Santa Clara Medical Association noted.⁵ As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

EHT has a longstanding history of research and policy advice to state, local and national governments regarding strategies to reduce disease and promote health by avoiding environmental health hazards. Our organization opposes the broad scale installation of untested wireless antennas and associated electrical equipment close to humans and through critical wildlife habitat and corridors. Both federal and local zoning controls are needed to assure that cellular equipment are installed to avoid significant and serious safety threats of electrical shock, fire, and radio frequency (RF) microwave radiation exposures, as well as chronic impacts on public health and the environment.

Consistent with public health concepts of preventing harm by reducing exposure to suspected carcinogens, EHT opposes the usurpation and preemption of local authority that will allow federal and state authorities to place what state reports of the bill indicate can be thirty thousand new radiating 5G cell antennas on city and county utility, light poles, and other right of ways in close proximity to city and county workers, children, residents and visitors. In some cases towers will need to be sited every 100 feet with antennas at a height of 30 feet or less. Local authority and duty should not be overridden by preemptive federal or state policies such as SB 649 which disregards scientific evidence on this matter as outlined below.

Regarding potential health risks from RF a number of corporations advise their shareholders that they face serious risks from RF. For instance, Crown Castle's [2016 10-K ANNUAL REPORT](#), states that,

"If radio frequency emissions from wireless handsets or equipment on our wireless 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...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.

Regarding public health impacts, recently released research findings from the premiere test program of the National Institute of Environmental Health Sciences (NIEHS) add to the body of scientific evidence

⁴ Feldman, Yuri, et al. "[Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range.](#)" *Physical Review Letters*, vol. 100, no. 128102, 2008.

⁵ Russell, Cindy. "[A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?](#)" Santa Clara Bulletin, Jan./Feb. 2017.

indicating that RF microwave radiation can be harmful. The 10 year \$25 million NIEHS National Toxicology Program's [Studies of the Toxicology and Carcinogenicity Cell Phone Radiation](#) reports that RF produced increases rates of highly malignant very rare tumors: gliomas of the brain and schwannomas of the heart.⁶ These experimental findings are consistent with human studies showing increased rates of gliomas and acoustic neuromas (schwann cells) among humans exposed to cell phone radiation. In addition to increased cancers, the NTP study also reported that prenatally exposed animals produced offspring with lower birth weight and [evidence of direct genetic damage](#).

Since the 2011 WHO/IARC classification, the peer reviewed research connecting microwave exposure to cancer has significantly strengthened. In [2015, a study](#) replicated a 2010 [experiment](#) that found that weak cell phone signals significantly promote the growth of tumors in mice, and that toxic chemical exposures combine with RF to more than double the tumor response.^{7,8} The Ramazzini Institute is engaged in similar research with RF that is 1000 less than the NTP exposures—set to mimic radiation exposure levels caused by network equipment (e.g., cell tower antenna emissions).

Consistent with the [NTP findings](#), the Ramazzini Institute team [report](#) significantly lower litter weights, as presented at the January 2017 [Conference on Wireless and Health](#) at Israel Institute for Advanced Study, Hebrew University of Jerusalem.⁹ Findings of effects at such low levels is indication of the capability of low level electromagnetic radiation exposure to result in biological effects.

Other studies finding serious increased risk of glioma in regular cell phone users are of special relevance. In 2014, a [French national study](#) linked higher cell phone exposure to increased glioma in cell phone users.¹⁰ A newly published research [report](#) in the *American Journal of Epidemiology* finds that Canadians who have used cell phones for 558 hours or more have more than a doubled risk of brain cancer.¹¹ Previous [published re-analysis](#) of the multi country Interphone study data has found stronger positive associations to glioma risk among long term users and heavy users and a [statistically significant](#) association between where tumors were located and how much radiation an individual received from their phone.^{12,13}

⁶ Wyde, Michael, et al. "[Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats \(Whole Body Exposure\)](#)." *bioRxiv*, no. 055699, 2016.

⁷ Lerchl, Alexander, et al. "[Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans](#)." *Biochemical and Biophysical Research Communications*, vol. 459, no. 4, 2015, pp. 585-90.

⁸ Tillmann, Thomas, et al. "[Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model](#)." *International Journal of Radiation Biology*, vol. 86, no. 7, 2010, pp. 529-41.

⁹ Belpoggi, Fiorella. "[Recent findings on wireless radiation and health from the Ramazzini Institute could reinforce the NTP results](#)." *Conference on Wireless and Health*, 2017.

¹⁰ Coureau, Gaëlle, et al. "[Mobile phone use and brain tumours in the CERENAT case-control study](#)." *Occupational Environmental Medicine*, vol. 71, no. 7, 2014, pp. 514-22.

¹¹ Momoli, F., et al. "[Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors](#)." *American Journal of Epidemiology*, 2017.

¹² Turner, Michelle C., et al. "[Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries](#)." *Annals of Epidemiology*, vol. 26, 12, 2016, pp. 827-32.

More recently, research carried out by physicists in Israel and others have shown that the higher millimeter wave frequencies to be used in 5G applications uniquely interacts with sweat ducts of the human skin which can then function as antennas to amplify signals. This work extends studies first produced in 1986.¹⁴ The potential long-term impact of such stimulation on precancerous skin growths should be evaluated carefully, including potential super-growth of bacteria.¹⁵ A [lecture](#) by Paul Ben-Ishai, PhD, and published research on this issue can be found on the [2017 Conference website](#).^{16, 17, 18}

Cancer is not the only health concern presented by wireless devices and infrastructure. Impacts on [reproduction](#) and [brain development](#) have also been repeatedly reported in the peer reviewed literature in addition to a myriad of other adverse effects.^{19, 20, 21, 22}

In light of these developments showing growing evidence of the biological impact of RF, it is imperative that new infrastructure and 5G not be introduced widely into commerce at this time. The State of California needs to critically consider the potential impact of massive new and possibly carcinogenic wireless exposures to their population. Before introducing additional untested wireless technology into the environment, it is necessary to:

- model exposures to infants, children and pregnant women;
- conduct experimental tests on exposures' impacts on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology

In 2015, the [International EMF Scientist Appeal](#), now signed by over 225 scientists from 41 nations, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization and U.N. Member Nations urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about

¹³ Grell, Kathrine, et al. ["The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study."](#) *American Journal of Epidemiology*, vol. 184, no. 11, 2016, pp. 818-28.

¹⁴ Gandhi OP, Riaz A. ["Absorption of millimeter waves by human beings and its biological implications."](#) *IEEE Transactions on Microwave Theory and Techniques*, vol. 34, no. 2, 1986, pp. 228-235.

¹⁵ Soghomonyan D, K. Trchounian and A. Trchounian. ["Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?"](#) *Applied Microbiology and Biotechnology*, vol. 100, no. 11, 2016, pp. 4761-71.

¹⁶ Feldman, Yuri and Paul Ben-Ishai. ["Potential Risks to Human Health Originating from Future Sub-MM Communication Systems."](#) *Conference on Wireless and Health*, 2017.

¹⁷ Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. ["Circular polarization induced by the three-dimensional chiral structure of human sweat ducts."](#) *Physical Review E*, vol. 89, no. 042715, 2014.

¹⁸ Feldman, Yuri, et al. ["Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range."](#) *Physical Review Letters*, vol. 100, no. 128102, 2008.

¹⁹ Adams, Jessica A., et al. ["Effect of mobile telephones on sperm quality: a systematic review and meta-analysis."](#) *Environment International*, 70, 2014, pp. 106-112.

²⁰ Deshmukh, P.S., et al. ["Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation."](#) *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

²¹ Aldad, T.S., et al. ["Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice."](#) *Scientific Reports*, vol. 2, no. 312, 2012.

²² Sonmez, O.F., et al. ["Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field."](#) *Brain Research*, vol. 1356, 2010, pp. 95-101.

health risks, particularly risks to children and fetal development.²³ Most recently, the EMF Scientists have submitted [Comments to the FCC](#) asking the FCC to critically consider the potential impact of the 5th generation wireless infrastructure on the health and safety of the U.S. population before proceeding to deploy this infrastructure.

California firefighters have lobbied to protect themselves and successfully received exemption on health grounds from the installation of these cell towers. Similarly cities and counties should be given the needed local controls to protect their citizens from the health and safety risks of these installations. As currently envisioned, transmitters can be placed in close proximity to bedrooms and schools without consideration of the health of their occupants. Research is critically needed to evaluate the public health and environmental impacts of proposed wireless facilities before deployment.

Worldwide, governments are acting to minimize exposures to children as they are most vulnerable. For example, the Supreme Court of India upheld the High Court of the State of Rajasthan's decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because of radiation "hazardous to life." In Chile, the 2012 "[Antennae Law](#)" prohibits cell antennae/towers in "sensitive areas".²⁴ Please learn more about international policy actions such as these in our [online briefing](#).²⁵

The assumption that all wireless technology is safe has been shown through recent studies to be incorrect. EHT strongly opposes the widespread installation of 5G antennas and towers and believes that the state should move forward on its commitment to support the installation of fiber optic cables buried in the ground to every business, home, school, and hospital in California. We urge the state not to ignore this evidence of harm from RF. Please vote "no" vote on SB 649 and uphold the rights of local government to protect public health and the environment.

Sincerely,



Devra Davis, PhD, MPH

Fellow, American College of Epidemiology

Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayıs Univ. Medical School

Associate Editor, *Frontiers in Radiation and Health*

President, Environmental Health Trust

²³ Blank, M., et al. "[International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure.](#)" *European Journal of Oncology*, vol. 20, no. 3/4, 2015, pp. 180-2.

²⁴ "[New communications antenna law in Chile.](#)" *Communications Law: Newsletter of the International Bar Association Legal Practice Division*, vol. 20, no. 1, 2013, pp. 14-16.

²⁵ "[International Policy Briefing: Cautionary Policy on Radiofrequency Radiation Actions by Governments, Health Authorities and Schools Worldwide.](#)" Environmental Health Trust, 2017.

July 26, 2017

The Honorable Ben Hueso
Member of the California State Senate
Room 4035, State Capitol
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities - OPPOSE

Dear Senator Hueso:

Environmental Working Group (EWG) respectfully opposes your SB 649, which would make the installation of small cell wireless facilities, such as those used to facilitate 5G networks, ministerial rather than discretionary at the local government level.

The health impacts of cellular transmissions have been debated for over ten years because there are studies that raise real concerns about the effects of radio frequency radiation on humans. This is why EWG sponsored two bills by former Senator Leno, SB 1212 (2010) and SB 932 (2011) that would have required sellers of cell phones to inform consumers to minimize exposure to cell phone radiation by reading the manual that comes with the phone, as this is in fact recommended by cell phone manufacturers in their included manuals.

Studies on the health impacts of cell phones and their transmission infrastructure are continuing, but there is already adequate existing sound science for government to proceed with caution on the roll-out of the new technology. In particular, the results of the \$25 million National Toxicology Program study (2016) that showed tumors in rats caused by a typical amount of heavy cell phone use are to be reckoned with. And, most of the past science has analyzed older cellular technology like 2G and 4G, so we are moving into uncharted waters with 5G with its different wavelengths and energy levels.

Local governments must be able to evaluate science and respond to the wishes of their citizens and neighborhoods before permits are issued for this technology and SB 649 short-circuits that process. This includes important decisions about locating the technology near homes, schools, and hospitals. We simply cannot rely upon the word of the FCC (in terms of safety standards) to protect the health of Californians.

For these reasons, EWG will be urging a “no” vote for the Assembly floor. We will be writing a separate letter to the Assembly Appropriations Committee on fiscal concerns.

Sincerely,



Bill Allayaud
California Director of Government Affairs
Environmental Working Group

Martin Pall, PhD

August 7, 2017

Dear California Legislators,

I am Dr. Martin Pall, Professor Emeritus of Biochemistry and Basic Medical Sciences at Washington State University. I am a published and widely cited scientist on the biological effects of electromagnetic fields and speak internationally on this topic. I am particularly expert in how wireless radiation impacts the electrical systems in our bodies. I have published 7 studies showing there exists exquisite sensitivity to electromagnetic fields (EMFs) in the voltage sensor in each cell, such that the force impacting our cells at the voltage sensor has massive impact on the biology on the cells of our bodies [1-7]. These papers are discussed in over 360,000 web sites which can be easily found by Googling (Martin Pall electromagnetic). I received my PhD at Caltech, one of the top scientific institutions in the world.

EMFs act by activating channels in the membrane that surrounds each of our cells, called voltage-gated calcium channels (VGCCs). The EMFs put forces on the voltage sensor that controls the VGCCs of about 7.2 million times greater than the forces on other charged groups in our cells [4,6,7]. This is why weak EMFs have such large biological effects on the cells of our bodies! EMFs works this way not only on human and diverse animal cells [1-7] but also in plant cells [7] so that this is a universal or near universal mechanism of action.

Thousands of published studies show biological and health effects from electromagnetic fields. We now know the mechanism that can explain these effects. The mechanism is a function of the electromagnetics of each cell—not solely about heating effects from the radiation (on which present FCC guidelines are based).

This new understanding [1-7] means we can debunk the claims of the wireless industry that there cannot be a mechanism for effects produced by these weak EMFs. The 20 years plus of industry propaganda claims are false. Rather the thousands of studies showing diverse health impacts of these EMFs can be explained. We now have a mechanism, one that is supported by both the biology and the physics, both of which are pointing in exactly the same direction. I am sending as a separate document a list of 134 reviews, each of which provides from 12 to over a thousand individual citations showing health impacts of low intensity EMFs, EMFs that the telecommunications industry claims cannot have such effects. **These 134 reviews and thousands of primary scientific papers they cite show that the industry propaganda has no scientific support whatsoever.**

The consensus among independent scientists on this is further confirmed by the 2015 (and later) appeal made to the United Nations and member states, stating that the current EMF safety guidelines are inadequate because they do not take into consideration non-thermal effects. This was signed by 225 scientists from 41 countries, each of whom had

published peer reviewed studies on EMF health effects – a total of 2,000 papers published in this area by the signers, a substantial fraction of the total publications in this area.

According to industry, the forces electromagnetic fields place on electrically-charged groups in the cell are too weak to produce biological effects. However, the unique structural properties of the voltage-gated calcium channel (VGCC) protein can, it turns out, explain why the force on a cell's voltage sensor from low-intensity EMFs are millions of times stronger than are the forces on singly-charged groups elsewhere in the cell.

It would be a disaster for the health of Californians to be exposed to the antennas envisioned in SB.649. The State of California would be making a grave mistake to proceed with supporting the commercial interests of the wireless industry with this legislation. **Legislators would best pause to understand the gravity of the biological effects, and the ramifications for physical and mental health, as well as consequences from continual damage to human DNA, and learn the facts from scientists who are independent of the wireless industry, not from the industry lobbyists who have a gigantic conflict of interest.**

VGCC activation in cells produced by low intensity EMFs can explain long-reported findings that electromagnetic fields and a wide range of biological changes and health effects. The first 6 of these (see below) were well documented 46 years ago in the U.S. Office of Naval Medical Research report, published in 1971 [8]. The others that follow have been extensively documented subsequently in the peer-reviewed scientific literature:

- 1) Various neurological/neuropsychiatric effects, including changes in brain structure and function, changes in various types of psychological responses and changes in behavior.
- 2) At least eight different endocrine (hormonal) effects.
- 3) Cardiac effects influencing the electrical control of the heart, including changes in ECGs, producing arrhythmias, changes that can be life threatening.
- 4) Chromosome breaks and other changes in chromosome structure.
- 5) Histological changes in the testes.
- 6) Cell death (what is now called apoptosis, a process important in neurodegenerative diseases).
- 7) Lowered male fertility including lowered sperm quality and function and also lowered female fertility (less studied).
- 8) Oxidative stress.
- 9) Changes in calcium fluxes and calcium signaling.
- 10) Cellular DNA damage including single strand breaks and double strand breaks in cellular DNA and also 8-OHdG in cellular DNA.
- 11) Cancer which is likely to involve these DNA changes but also increased rates of tumor promotion-like events.
- 12) Therapeutic effects including stimulation of bone growth.
- 13) Cataract formation (previously thought to be thermal, now known not to be).
- 14) Breakdown of the blood-brain barrier.
- 15) Melatonin depletion and sleep disruption.

They may be low intensity but with regard to the VGCCs, electromagnetic fields can have a tremendously powerful impact on the cells of our bodies. Furthermore, published studies showing that calcium channel blocker drugs block or greatly lower biological effects from electromagnetic fields confirm there is a VGCC activation mechanism that is causing various effects. Higher frequency electromagnetic fields from 5G technologies on the horizon pose even greater biological concern than those to which we are exposed today. We should be moving, instead, to wired technologies at every opportunity, based on what we know in science today, not expanding and supporting the proliferation of wireless.

I want to make several additional points very clear:

1. The Physics and the Biology are both pointing in the same direction. Both show that EMFs act primarily via activating the VGCCs in the cells of our bodies.
2. DNA damage known to be produced by these EMFs occur in human sperm and may also occur in human eggs, leading to large increases in mutation in any children born. It is thought that an increase in mutation frequency of 2.5 to 3-fold will lead to extinction because of accumulation of large numbers of damaging mutations. We may already be over this level, and if so, simply continuing our current exposures will lead to eventual extinction. Further increases in exposures will be more rapidly self-destructive.
3. Pulsed EMFs are, in most cases, more biologically active and therefore more dangerous than are non-pulsed (continuous wave) EMFs. All cordless communication devices communicate via pulsations, because it is the pulsations that carry the information communicated. All the industry claims of safety are based on a theory (only thermal effects) that was known to be wrong back in 1971 [8] – and that was before many thousands of additional studies were published providing massive confirmation that industry claims are false.
4. The industry is trying to move to much higher frequencies because these much higher frequencies allow much higher pulsations and therefore much higher transmission of information. However, these higher pulsation rates make these ultra-high devices vastly more dangerous. This is part of the reasons why it is so important to vote down SB.649.
5. None of our wireless communication devices are ever tested biologically for safety – not cell phone towers, not cell phones, not Wi-Fi, not cordless phones, not smart meters and certainly not 5G phones, or radar units in cars – before they are put out to irradiate an unsuspecting public.
6. The telecommunications industry has corrupted the agencies that are supposed to be regulating them. The best example of this is that the FCC which regulates EMFs in the U.S. is a “captured agency”, captured by the industry it is supposed to regulate, according to an 8 chapter document published by the Edmond J. Safra Center for Ethics at Harvard University [9]. Is it any wonder, therefore, that the industry keeps touting that their devices are within the safety guidelines set by the FCC?

I urge you to do the right thing on behalf of the health of Californians and future generations. Please let me know if I can provide further information. (503) 232-3883.

Sincerely,

Martin Pall, PhD (Caltech, 1968)

Professor Emeritus of Biochemistry and Basic Medical Sciences
Washington State University

Citations:

1. Pall ML. 2013 Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965.
2. Pall ML. 2014 Electromagnetic field activation of voltage-gated calcium channels: role in therapeutic effects. *Electromagn Biol Med*. 2014 Apr 8.
3. Pall ML. 2015 Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev Environ Health* 30:99-116.
4. Pall ML. 2015 Elektromagnetische Felder wirken über die Aktivierung spannungsabhängiger Calciumkanäle, um günstige oder ungünstige Wirkungen zu erzeugen. *Umwelt-Medizin-Gesellschaft* 28: 22-31.
5. Pall ML. 2015 How to approach the challenge of minimizing non-thermal health effects of microwave radiation from electrical devices. *International Journal of Innovative Research in Engineering & Management (IJIREM)* ISSN: 2350-0557, Volume-2, Issue -5, September 2015; 71-76.
6. Pall ML. 2016 Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression. *J Chem Neuroanat* 75(Pt B):43-51. doi: 10.1016/j.jchemneu.2015.08.001. Epub 2015 Aug 21.
7. Pall ML. 2016 Electromagnetic fields act similarly in plants as in animals: Probable activation of calcium channels via their voltage sensor. *Curr Chem Biol* 10: 74-82.
8. Naval Medical Research Institute Research Report, June 1971. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations, Revised, ZR Glaser.
9. *Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*, by Norm Alster. Published by Edmond J. Safra Center for Ethics, Harvard University. An e-book under the Creative Commons 4.0 License: <https://creativecommons.org/licenses/by/4.0/>

June 27, 2017

Assembly Member Cecilia M. Aguiar-Curry
Local Government Committee Chair
State Capitol
P.O. Box 942849
Sacramento, CA 94249-0004
Via email

Re: SB 649 - OPPOSE

Dear Chair Aguiar-Curry,

On behalf of The Greenlining Institute, I am writing to express our opposition to SB 649. SB 649 will not close the digital divide. Instead, it will allow phone and broadband providers to override community decisions about how those communities use public space. Additionally, SB 649 will allow providers to use community-owned property without paying just compensation.

Local Communities Fully Understand the Need for Advanced Phone and Broadband Services.

Every community in California is eager to see faster, more reliable, and more affordable phone and broadband service. Local governments are very aware that advanced telephone and broadband services are critical for access to educational, employment, and economic opportunities. Access to these opportunities is particularly critical for communities of color, who, as a result of the racial wealth and income divides, are more likely to live in areas that lack access to advanced phone and broadband services. State and local governments are particularly well-positioned to ensure that providers are serving communities equitably and non-discriminatorily and that community members have equitable access to economic opportunity.

SB 649 Would Not Help Close The Digital Divide.

Sadly, communications providers have repeatedly demonstrated that they will not make advanced services available to low-income or rural areas unless **they are required to do so**. SB 649 contains no such requirement, instead allowing providers to pick and choose where to build their networks without any community input. Under SB 649, it is likely that providers will focus any service improvements on high-income areas. SB 649 in no way guarantees that low-income communities and communities of color will gain increased access to advanced communications services. Accordingly, SB 649 will not help close the digital divide.

For Express Mail
7100 N Rachel Way
Unit 6 Eagles Rest
Teton Village WY 83025



For U.S. Mail
P.O. Box 58
Teton Village WY 83025
www.ehtrust.org

The Honorable Jerry Brown
Governor, State of California
c/o State Capitol, Suite 1173
Sacramento, CA 95814
September 17, 2017

RE: SB 649 (Hueso) – Small Cell Wireless Facilities — OPPOSE

Honorable Governor Brown,

As a nonprofit research and policy organization dedicated to identifying and reducing environmental health hazards, Environmental Health Trust (EHT) writes to advise you of serious scientific grounds to veto SB 649 as advanced by Senator Hueso. I have personally served as an expert advisor to the California Department of Public Health as well as the city of San Francisco and Berkeley governments on matters relevant to this bill.

You are globally recognized as a champion of the environment and public health. I remain deeply grateful to you for your forward thinking on climate change and toxics policies which provide moral and political leadership at a time when it is sorely lacking. As someone who has been a presidential appointee confirmed by the US Senate, I fully understand the challenges that you face politically. You have provided leadership on the right side of history in too many ways to enumerate.

EHT has a longstanding history of research and policy advice to state, local and national governments regarding strategies to reduce disease and promote health by avoiding environmental health hazards. Our organization opposes the broad scale installation of untested wireless antennas and associated electrical equipment close to humans and through critical wildlife habitat and corridors.

The assumption that all wireless technology is safe has been shown through recent studies to be incorrect. EHT strongly opposes the widespread installation of 5G antennas and towers and believes that the state should move forward on its commitment to support the installation of fiber optic cables buried in the ground to every business, home, school, and hospital in California. We urge the state not to ignore this evidence of harm from wireless technologies.

Specific design standards must first be funded and created for 5G facilities for the more than thirty thousand expected new radiating 5G cell antennas to be constructed on city and county utility light poles and in the right of ways in close proximity to city and county workers, children, residents and visitors. Both federal and local zoning controls are absolutely needed to assure that cellular equipment are installed to avoid significant and serious safety threats of electrical shock, fire, and radio frequency (RF) microwave radiation exposures, as well as chronic impacts on public health and the environment.

Now the challenge before you is one of the most momentous you will have ever faced. The telecom industry is a global multi-trillion dollar phenomenon. They have provided massive amounts of political support throughout the political spectrum. Despite this, the weight of science has inexorably demonstrated that the experiment they

have been conducting on ourselves and our progeny is without merit and has already exacted a serious toll for public health.

SB 649 will pave the way for widespread introduction of 5G microwave wireless radiation frequency (RF) that has never been tested for its impact of public health or the environment. Other RF microwave radiation such as that used by cellphones and other wireless devices has been [classified as a 'possible carcinogen'](#) by the International Agency for Research on Cancer in 2011 and more recently dubbed a ['probable carcinogen.'](#) by expert researchers looking at newer information in 2015.^{1,2,3} In addition, this bill could result in the loss of hundreds of millions of dollars in local revenue, as the [San Francisco Chronicle noted](#) today.

By ignoring growing scientific evidence of harm, the bill effectively will ensure the widespread exposures of millions of Californians to an agent that growing numbers of scientists and nations consider a serious health threat. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects⁴, as Dr. Cindy Russell, Vice President of Community Health for the Santa Clara Medical Association noted.⁵ As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

State and local authority and duty should not be overridden by any preemptive policies such as SB 649 which disregards scientific evidence on this matter as outlined below. Regarding potential health risks from RF a number of corporations advise their shareholders that they face serious risks from RF. For instance, Crown Castle's [2016 10-K ANNUAL REPORT](#), states that,

"If radio frequency emissions from wireless handsets or equipment on our wireless 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...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."

¹ World Health Organization. ["IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans."](#) WHO, Press Release, no. 208, 2011.

² IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. ["Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields." IARC Monographs On The Evaluation of Carcinogenic Risks to Humans](#), vol. 102, pt. 2, 2013.

³ Morgan, L. Lloyd, et al. ["Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen \(2A\)." International Journal of Oncology](#), vol. 46, no. 5, 2015, 1865-71.

⁴ Feldman, Yuri, et al. ["Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range."](#) *Physical Review Letters*, vol. 100, no. 128102, 2008.

⁵ Russell, Cindy. ["A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?"](#) Santa Clara Bulletin, Jan./Feb. 2017.

Most wireless companies from [AT&T](#) to [Nokia](#) to [T Mobile](#) to [Verizon Wireless](#) have issued [similar warnings](#) to their shareholders.

Regarding public health impacts, recently released research findings from the premiere test program of the National Institute of Environmental Health Sciences (NIEHS) add to the body of scientific evidence indicating that RF microwave radiation can be harmful. The 10 year \$25 million NIEHS National Toxicology Program's [Studies of the Toxicology and Carcinogenicity Cell Phone Radiation](#) reports that RF produced increases rates of highly malignant very rare tumors: gliomas of the brain and schwannomas of the heart.⁶ These experimental findings are consistent with human studies showing increased rates of gliomas and acoustic neuromas (schwann cells) among humans exposed to cell phone radiation. In addition to increased cancers, the NTP study also reported that prenatally exposed animals produced offspring with lower birth weight and [evidence of direct genetic damage](#).

Since the 2011 WHO/IARC classification, the peer reviewed research connecting microwave exposure to cancer has significantly strengthened. In [2015, a study](#) replicated a 2010 [experiment](#) that found that weak cell phone signals significantly promote the growth of tumors in mice, and that toxic chemical exposures combine with RF to more than double the tumor response.^{7,8} The Ramazzini Institute is engaged in similar research with RF that is 1000 less than the NTP exposures—set to mimic radiation exposure levels caused by network equipment (e.g., cell tower antenna emissions).

Consistent with the [NTP findings](#), the Ramazzini Institute team [report](#) significantly lower litter weights, as presented at the January 2017 [Conference on Wireless and Health](#) at Israel Institute for Advanced Study, Hebrew University of Jerusalem.⁹ Findings of effects at such low levels is indication of the capability of low level electromagnetic radiation exposure to result in biological effects.

Other studies finding serious increased risk of glioma in regular cell phone users are of special relevance. In 2014, a [French national study](#) linked higher cell phone exposure to increased glioma in cell phone users.¹⁰ A newly published research [report](#) in the *American Journal of Epidemiology* finds that Canadians who have used cell phones for 558 hours or more have more than a doubled risk of brain cancer.¹¹ Previous [published re-analysis](#) of the multi country Interphone study data has found stronger positive associations to glioma risk

⁶ Wyde, Michael, et al. "[Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats \(Whole Body Exposure\)](#)." *bioRxiv*, no. 055699, 2016.

⁷ Lerchl, Alexander, et al. "[Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans](#)." *Biochemical and Biophysical Research Communications*, vol. 459, no. 4, 2015, pp. 585-90.

⁸ Tillmann, Thomas, et al. "[Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model](#)." *International Journal of Radiation Biology*, vol. 86, no. 7, 2010, pp. 529-41.

⁹ Belpoggi, Fiorella. "[Recent findings on wireless radiation and health from the Ramazzini Institute could reinforce the NTP results](#)." *Conference on Wireless and Health*, 2017.

¹⁰ Coureau, Gaëlle, et al. "[Mobile phone use and brain tumours in the CERENAT case-control study](#)." *Occupational Environmental Medicine*, vol. 71, no. 7, 2014, pp. 514-22.

¹¹ Momoli, F., et al. "[Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors](#)." *American Journal of Epidemiology*, 2017.

among long term users and heavy users and a [statistically significant](#) association between where tumors were located and how much radiation an individual received from their phone.^{12,13} A [2017 review](#) published by Hardell and Carlberg concludes that “RF radiation should be regarded as a human carcinogen causing glioma.”¹⁴ I invite you to view videos from Environmental Health Trust’s expert forum in Jackson Hole, Wyoming on July 30, 2017 where longtime World Health Organization advisor [Dr. Anthony Miller](#) presented the scientific evidence for his [updated opinion](#) that RF is a human carcinogen.

More recently, [research](#) carried out by physicists in Israel and others have shown that the higher millimeter wave frequencies to be used in 5G applications uniquely interacts with sweat ducts of the human skin which can then function as antennas to amplify signals.¹⁵ This work extends studies first produced in 1986.¹⁶ The potential long-term impact of such stimulation on precancerous skin growths should be evaluated carefully, including potential super-growth of bacteria.¹⁷ A [lecture](#) by Paul Ben-Ishai, PhD, and published research on this issue can be found on the [2017 Conference website](#).^{18,19,20}

Cancer is not the only health concern presented by wireless devices and infrastructure. Impacts on [reproduction](#) and [brain development](#) have also been repeatedly reported in the peer reviewed literature in addition to a myriad of other adverse effects.^{21, 22, 23, 24}

¹² Turner, Michelle C., et al. "[Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries.](#)" *Annals of Epidemiology*, vol. 26, 12, 2016, pp. 827-32.

¹³ Grell, Kathrine, et al. "[The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study.](#)" *American Journal of Epidemiology*, vol. 184, no. 11, 2016, pp. 818-28.

¹⁴ Carlberg, Michael, and Lennart Hardell. "[Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation.](#)" *BioMed Research International* 2017.9218486 (2017).

¹⁵ Betzalel, Noa, Yuri Feldman, and Paul Ben Ishai. "[The Modeling of the Absorbance of Sub-THz Radiation by Human Skin.](#)" *IEEE Transactions on Terahertz Science and Technology* 7.5 (2017): 521-8.

¹⁶ Gandhi OP, Riaz A. "[Absorption of millimeter waves by human beings and its biological implications.](#)" *IEEE Transactions on Microwave Theory and Techniques*, vol. 34, no. 2, 1986, pp. 228-235.

¹⁷ Soghomonyan D, K. Trchounian and A. Trchounian. "[Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?](#)" *Applied Microbiology and Biotechnology*, vol. 100, no. 11, 2016, pp. 4761-71.

¹⁸ Feldman, Yuri and Paul Ben-Ishai. "[Potential Risks to Human Health Originating from Future Sub-MM Communication Systems.](#)" *Conference on Wireless and Health*, 2017.

¹⁹ Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "[Circular polarization induced by the three-dimensional chiral structure of human sweat ducts.](#)" *Physical Review E*, vol. 89, no. 042715, 2014.

²⁰ Feldman, Yuri, et al. "[Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range.](#)" *Physical Review Letters*, vol. 100, no. 128102, 2008.

²¹ Adams, Jessica A., et al. "[Effect of mobile telephones on sperm quality: a systematic review and meta-analysis.](#)" *Environment International*, 70, 2014, pp. 106-112.

²² Deshmukh, P.S., et al. "[Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation.](#)" *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

²³ Aldad, T.S., et al. "[Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice.](#)" *Scientific Reports*, vol. 2, no. 312, 2012.

²⁴ Sonmez, O.F., et al. "[Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field.](#)" *Brain Research*, vol. 1356, 2010, pp. 95-101.

In light of these developments showing growing evidence of the biological impact of RF, it is imperative that new infrastructure and 5G not be introduced widely into commerce at this time. The State of California needs to critically consider the potential impact of massive new and possibly carcinogenic wireless exposures to their population. Before introducing additional untested wireless technology into the environment, it is necessary to:

- model exposures to infants, children and pregnant women;
- conduct experimental tests on exposures' impacts on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology

In 2015, the [International EMF Scientist Appeal](#), now signed by over 225 scientists from 41 nations, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization and U.N. Member Nations urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about health risks, particularly risks to children and fetal development.²³ The EMF Scientists later submitted [Comments to the FCC](#) asking the FCC to critically consider the health impact of the 5G.

Most recently, in September 2017, over 180 scientists and doctors from 35 countries sent a [declaration](#) to the European Union calling for a moratorium on 5G expansion citing potential neurological impacts, infertility, and cancer.²⁵

California firefighters have [lobbied](#) to protect themselves and successfully received exemption on health grounds from the installation of these cell towers.²⁶ Similarly cities and counties should be given the needed local controls to protect their citizens from the health and safety risks of these installations. As currently envisioned, transmitters can be placed in close proximity to bedrooms and schools without consideration of the health of their occupants. Research is critically needed to evaluate the public health and environmental impacts of proposed wireless facilities before deployment.

The organization that I founded a decade ago, Environmental Health Trust, is not opposing cell phones. We are in favor of public health and we note that the California Department of Public Health has [drafted guidelines](#) for safer use of phones so that the public reduce radiofrequency exposure for more than a decade.

As my colleagues who have been supported by the US Department of Defense on 5G have written to you, the evidence is compelling that this technology can interact with human body in ways that have never been evaluated for their long-term impact on health and safety. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects²⁷, as Dr. Cindy Russell, Vice

²⁵ [“Appeal to the European Union: Scientists warn of potential serious health effects of 5G.”](#) 13 September 2017.

²⁶ [““The Firefighters Wake Up Call To Us All” By Susan Foster RE: SB 649 Opposing Cell Towers In Rights Of Way.”](#) *Environmental Health Trust* (2017).

²⁷ Feldman, Yuri, et al. [“Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range.”](#) *Physical Review Letters*, vol. 100, no. 128102, 2008.

For Express Mail
7100 N Rachel Way
Unit 6 Eagles Rest
Teton Village WY 83025



For U.S. Mail
P.O. Box 58
Teton Village WY 83025
www.ehtrust.org

President of Community Health for the Santa Clara Medical Association noted.²⁸ As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

Cardiologists are reporting increased numbers of patients with atrial fibrillation and heart disease who have no inherited risk factors. A recent study by Professor Gemma Figtree, published in the [European Journal of Preventive Cardiology](#), found that the rate of heart attacks and heart disease in persons with no known risk factors has more than doubled in less than a decade.²⁹ Similar rates of serious eye problems and attention deficit disorder continue to increase without any knowns. Certainly, the phenomenal growth in the use of wireless technology should be explored as one of the explanations for these serious public health.

Please veto SB 649 and uphold the rights of local government to protect public health and the environment.

Sincerely,

A handwritten signature in black ink that reads "Devra Davis".

Devra Davis, PhD, MPH

Founder & President, Environmental Health Trust

Fellow, American College of Epidemiology

Visiting Professor of Medicine, Hebrew University of Jerusalem and Ondokuz Mayıs University

CC

Tom Dyer, Chief Deputy Legislative Affairs Secretary

[Letter from Dr. Paul Ben Ishai to Governor Brown](#)

[Order Instituting Rulemaking to update the Commission's policies and procedures related to Rulemaking 04-08-020 electromagnetic fields emanating from regulated \(Filed August 19, 2004\) utility facilities.](#)

²⁸ Russell, Cindy. ["A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?"](#) Santa Clara Bulletin, Jan./Feb. 2017.

²⁹ Vernon, Stephen T., et al. "Increasing proportion of ST elevation myocardial infarction patients with coronary atherosclerosis poorly explained by standard modifiable risk factors." *European Journal of Preventive Cardiology* (2017). doi: [10.1177/2047487317720287](#).

A 5G Wireless Future: Will it give us a Smart Nation or contribute to an Unhealthy One?

Dr. Cindy Russell

SCCMA V.P. Community health

“It would greatly extend FCC’s current policy of the mandatory irradiation of the public without adequate prior study of the potential health impact and assurance of safety. It would irradiate everyone, including the most vulnerable to harm from radiofrequency radiation: pregnant women, unborn children, young children, teenagers, men of reproductive age, the elderly, the disabled, and the chronically ill.” —Ronald Powell, PhD, Letter to FCC on 5G expansion (7)

BRAVE NEW WORLD OF COMMUNICATION

The use of mobile wireless technologies continues to increase worldwide. A new faster 5th generation (5G) telecommunication system has recently been approved by the Federal Communications Commission(FCC) with new antennas already being installed and tested in Palo Alto and Mountain View. While it may give us uber automation and instantaneous “immersive entertainment” a lot of questions remain with regards to public health and safety of wireless devices. Will the adoption of this new 5G technology harm directly or indirectly the consumers and businesses it hopes to attract?

5G is the new promised land for wireless technology. It could connect us in our homes, workplaces and city streets to over a trillion objects around the world. (96) The Internet of Things (IoT) is primed to give us self-driving cars, appliances that can order their own laundry soap, automation hubs that pay your bills, not to mention fast movie downloads and virtual reality streaming from anywhere when you are on the go. Companies are already asking local cities and counties to move

forward to create “Smart Cities” which have comprehensive digital connectivity by installing a massive wireless sensor network of almost invisible small cell antennae on light posts, utility poles, homes and businesses throughout neighborhoods and towns in order to integrate IoT with IT. They state it will improve services, the economy and quality of life. This communication network will form an expanded electromagnetic microwave blanket above each city and county, permeating the airspace and providing seamless connectivity where people and things will exchange data.

Former Federal Communications Commission (FCC) chair Tom Wheeler called this a “National Priority” and thus ushered in approval for the addition of this new pervasive network of high frequency short wave millimeter broadband for commercial use first planned in urban areas.

Developing a “Smart” World?

Engineers and physicists are busy working out the details of carrier frequencies and the architecture of the new network. Manufacturing industries are already developing commonly used products that feature wireless integration that will connect to the densely clustered antennas. Marketing companies are now pushing ads for “smart” devices for “smart” people in “smart” cities. Even the healthcare industry is anticipating using some of these wearable devices for patients with cardiac conditions or to do remote surgery in other parts of the world. Opening up 5G Spectrum access hopes to drive an explosion of new products. The economic opportunities are obvious and business will be booming in the tech industry.

Concerns continue to rise however about the basic safety of our current use of wireless technologies not to mention adding layers of newer microwave frequencies that have not been tested for short term or long term safety. Important questions have not been addressed while industry and government policy have already moved forward.

 Why is the FCC streamlining permitting of 5G high frequency when they have not completed their investigation on health effects nor updated safety limits for low-intensity radio frequency radiation?

🏠 Is the widespread “deployment” of this pervasive higher frequency small cell distributed antennae system in our cities and on our homes safe for humans and the environment?

🏠 Will it add to the burden of chronic disease that costs our nation over a trillion dollars annually? (105)

🏠 Are we already digitally over connected, outsourcing our grey matter and becoming a dysfunctional addicted nation because of it? (136,137,138)

🏠 How will this affect our privacy, cyber security and the security of medical records?

🏠 Will we as physicians be able to recognize the emerging adverse health effects of new millimeter technology and wearable technology let alone that of current wireless devices?

Over the past century, this natural environment has sharply changed with introduction of a vast and growing spectrum of man-made EM fields.” Adey (135)

A Good Read: Federal Communications Commission 5G Letters

Letters to the FCC in 2016 responding to the 5G roll out with the addition of new high frequencies were mixed. Industry generally applauded the FCC for its efforts and discussed the growing demand for this technology along with a need for flexible regulation to implement it. Some expressed concerns about interference with other satellite systems. Some felt there should be maximum spectrum usage opening up even higher frequencies that are only experimental now in order to help “the underserved”. Others argued about opening this up to licensed versus unlicensed uses. Industry did not mention any potential public or environmental health hazards regarding the use of these new frequencies.

Raising a Red Flag to Push the Pause Button on 5G

Private citizens and Phd's, however did raise a red flag at the FCC, recommending a halt to infrastructure plans and more testing for health and environmental reasons. They questioned the current FCC standards which are outdated and not protective of human health. They asked "How will it affect children, pregnant women and the elderly who are the most vulnerable in our population?" While scientists gave ample evidence that precaution should prevail, I found the most compelling letters were from those who describe their fear as electro-sensitive people in an already dangerously high electromagnetic environment for them.

Gimme Shelter: No Escape for Electro-Sensitive Individuals

Linda K., a Michigan resident, explained how she became increasingly sensitive to EMF after a cell tower was placed within 1000 feet of her house.

She experienced insomnia at first and did not know there was a cell tower until several years later when she then associated the timing of its placement with her symptoms. After smart meters were installed in her area (but not on her house) she became sensitive to her laptop on wireless and her cell phone. Comcast then placed a Wi-Fi hotspot within 400 feet of her house and she stated her symptoms increased to the point that if she was outside in her yard more than 20 minutes she developed increasing fatigue, headaches, heart palpitations and high pitched ringing in her ears. These are all reported effects in those sensitive to EMF from wireless devices. She wrote about her concerns and that the new frequencies may add to her symptoms and inability to leave her house. (54)

In another letter Veronica Z. noted "This is a notice of survival. What many of us deal with currently is trying to survive in an environment that is hostile to us biologically. We have lost all of our rights, our finances, our homes, our ability to earn a living due to this ubiquitous exposure. We are being tortured every second of every day and have been reduced to simply trying to survive the moments we are alive. Others have been unable to do so and have opted to not stay living on this planet of torture...There is no escape for people with severe sensitivities to this deadly radiation." (55)

Ask NASA: Is Electro-Sensitivity Real or Imagined?

Are these people telling the truth? Is this just psychological? You may wonder, however, more and more people from all ages, professions and walks of life are relating similar symptoms in the presence of wireless devices. Some children reported these symptoms when their school adopted WiFi.

Dr. Scott Eberle, a well respected Petaluma hospice physician, eloquently described his development of electro-sensitivity in the November 2016 issue of the SCCMA Bulletin. He goes to great lengths to continue his profession, interact with his colleagues and maintain a healthy existence. (67)

We are exposed to increasing levels of microwave EMF in our daily lives. More scientific evidence links biologic effects with increased reports of health related effects including electrosensitivity. In 1971 Russian scientists Gordon and Sadchikova from the Institute of Labor Hygiene and Occupational Diseases described a comprehensive series of symptoms which they called ‘microwave sickness’ and presented this at an international WHO meeting. (109)

In a 1981 NASA report, “Electromagnetic Field Interactions: Observed Effects and Theories” microwave sickness was also described. The symptoms recorded were headaches, eyestrain, fatigue, dizziness, disturbed sleep at night, sleepiness in daytime, moodiness, irritability, unsociability, hypochondriac reactions, feelings of fear, nervous tension, mental depression, memory impairment, pulling sensation in the scalp and brow, loss of hair, pain in muscles and heart region, breathing difficulties, increased perspiration of extremities. (19)(63)(93)

The Science of Electro-Sensitivity

Belpomme, in 2015, completed the most comprehensive study of electrosensitivity, investigating 1216 people: 71.6% with EHS, 7.2% with CS, and 21.2% with both. They found an elevation in several reliable disease biomarkers—each occurring within a range of 23% to 40% of all cases—which prompted their conclusion that these sensitivities can be objectively characterized and diagnosed and “appear to involve inflammation-related hyper-histaminemia, oxidative stress, autoimmune response, capsulothalamic hypoperfusion and pathologic leakage of the blood-brain barrier, and a deficit in melatonin metabolic availability” (68)

The Science of EMF Biological Harm

The scientific literature abounds with evidence of non-thermal cellular damage from non-ionizing wireless radiation for several decades. There are likely several mechanisms both direct and indirect. Oxidative damage is one that has been well studied. Effects have been demonstrated on cell membranes causing a shift in the voltage gated calcium channels. Sperm studies have consistently found genotoxic, morphologic and motility abnormalities in the presence of cell phone radiation. DNA damage, blood brain barrier effects, melatonin reduction, nerve cell damage, mitochondrial disruption and memory disturbances have been revealed. The Bioinitiative Report (139) has chronicled these effects and a growing wave of PEER reviewed studies is building on that base daily. In 2011, the International Agency for Research on Cancer classified radiofrequency as 2B carcinogen and “possibly carcinogenic to humans”, the same category as DDT, lead and other pesticides

The Latest Science: National Toxicology Program Study on Cell Phones and Cancer

The most recent and compelling evidence has come from the 2016 National Institutes of Health, National Toxicology Program. Called the NTP Toxicology and Carcinogenicity Cell Phone Radiation Study, the 10 year \$25 million research revealed conclusively that there was a harmful effect from cell phone microwave radiation. (124,125) The frequencies are similar to other wireless devices we commonly use. The studies were robust, collaborative, well controlled and with double the number of rats required to reveal a significant effect, if present. The preliminary results of the study showed that RFR caused a statistically significant increase in two types of brain tumors, gliomas and schwannomas. These were the same two types of tumors shown to increase in human epidemiological studies on long term use of cell phones. Dr. Lennart Hardell and others have demonstrated a consistent pattern of increased incidence of ipsilateral (same side) acoustic neuromas (vestibular schwannomas) and gliomas with each 100 hours of cell phone use. (112-118) Another telling finding was that the control rats had much lower than expected cancer rates. It is believed due to the fact the control rats were in a controlled faraday cage and not exposed to normal ambient EMF that could contribute to cancer.

Ron Melnik, PhD, Senior Toxicologist and Director of Special Programs in the Environmental Toxicology Program at the National Institute of Environmental Health Sciences (NIEHS) and designer of the study states, “The NTP tested the hypothesis that cell phone radiation could not cause health effects and that hypothesis has now been disproved. The experiment has been done and, after extensive reviews, the consensus is that there was a carcinogenic effect.” (124,125,126,127)

Health Effects of Millimeter 5G Wavelengths

The term "millimeter waves" (MMW) refers to extremely high-frequency (30-300 GHz) electromagnetic radiation. Millimeter Waves (MMW) used in the next-generation of high-speed wireless technologies have shallow penetration thus effect the skin surface, the surface of the eye or on bacteria, plants and small life forms. Surface effects, however, can be quite substantial on an organism as stimulation of skin receptors can affect nerve signaling causing a whole body response with physiological effects on heart rate, heart rhythm, and the immune system.

In a 1998 review article, Pakhomov (123) looked at the bio-effects of millimeter waves. He reviewed dozens of studies and cites research demonstrating profound effects of MMW on all biological systems including cells, bacteria, yeast, animals and humans. Some effects were clearly thermal as millimeter microwaves are rapidly absorbed by water which is abundant in living organisms. When microwaves are absorbed the energy can cause tissue heating. Many of the millimeter frequency studies however showed effects without heating of tissues and at low intensities. Research was variable and showed both regenerative effects and also adverse effects depending on frequency, power and exposure time.

Arrythmias

Chernyakov induced heart rate changes in anesthetized frogs by microwave irradiation of remote skin areas. Complete denervation of the heart did not prevent the reaction. This suggested a reflex mechanism of the MMW action involving certain peripheral receptors.(28)

Heart Rate Variability

Potekhina found certain frequencies from 53-78 GHz band (CW) changed the natural heart rate variability in anesthetized rats. He showed that some frequencies had no effect (61 or 75 GHz) while other frequencies (55 and 73 GHz) caused pronounced arrhythmia. There was no change in skin or whole body temperature. (69)

Teratogenic Effects

One study of MMW teratogenic effects was performed in *Drosophila* flies by Belyaev. Embryos were exposed to 3 different GHz frequencies for 4-4.5 hours at 0.1 mW/cm². He found that irradiation at 46.35 GHz, but not at 46.42 or 46.50 GHz, caused marked effects including an increase in morphological abnormalities and decreased survival. It was felt the MMW disturbed DNA-protein interactions at that particular frequency. (65)

Bacterial Affects and Antibiotic Resistance

Bulgakova in over 1,000 studies with 14 different antibiotics showed how MMW exposure of *S. aureus* affects its sensitivity to antibiotics with different mechanisms of action. The MMW increased or decreased antibiotic sensitivity depending on the antibiotic concentration. (134)

Pakhomov warns, **“Regardless of the primary mechanism, the possibility of significant bio-effects of a short-term MMW irradiation at intensities at or below current safety standards deserves consideration and further study. The possibility of induction of adverse health effects by a local, low-intensity MMW irradiation is of potential significance for setting health and safety standards and requires special attention.”** He called for replication of studies especially long term effects of MMW.

His conclusions

- 1) Individuals or groups in a population, which would usually be regarded as uniform, may react to MMW in rather different or even opposite ways
- 2) There seem to exist unknown and uncontrolled factors that determine the MMW sensitivity of a specimen or a population. Irradiation could increase antibiotic resistivity in one experiment and decrease it in the next one
- 3) Increased sensitivity and even hypersensitivity of individuals to MMW may be real. Depending on the exposure characteristics, especially wavelength, a low-intensity MMW radiation was perceived by 30 to 80% of healthy examinees (123)

Cataracts

Prost in 1994 studied millimeter microwave radiation on the eye. He noted that microwaves of different wave-lengths can induce the development of cataracts. (13) His research found that low power millimeter waves produced lens opacity in rats exposed to 10mW/cm², a predisposing indicator of cataracts.(74)

Immune System

Kolomytseva, in 2002, looked at the dynamics of leukocyte number and functional activity of peripheral blood neutrophils under whole-body exposure of healthy mice to low-intensity extremely-high-frequency electromagnetic radiation (EHF EMR, 42.0 GHz, 0.15 mW/cm², 20 min daily).The study showed that the phagocytic activity of peripheral blood neutrophils was suppressed by about 50% in 2-3 h after a single exposure to EHF EMR.(131)

Chromatin Effects

Gapeve in 2003 showed for the first time that low-intensity extremely high-frequency MMH electromagnetic radiation in vivo causes effects on spatial organization of chromatin in cells of lymphoid organs. Chromatin is a complex of DNA and proteins that forms chromosomes within the nucleus of eukaryotic cells. He exposed mice to a single whole-body exposure for 20 min at 42.0 GHz and 0.15 mW/cm². (132)

Gene Expression

Habauzit in 2013 looked at gene expression in keratinocytes with 60GHz exposure at upper limit of current guidelines and concluded “In our experimental design, the high number of modified genes (665) shows that the ICNIRP current limit is probably too permissive to prevent biological response. (73)

Gaps in Data for Launching 5G millimeter devices

Commercial production often precedes research on consumer protection and health effects. We have too many toxins that have escaped premarket safety protocols for too long- lead, asbestos, smoking and our modern unregulated nanoparticles to mention just a few. These affect our long term and short term health in ways we do not even know. If we become ill, we do not question or identify the daily or weekly chemical exposures that could have contributed to that cancer or arthritis or lung disease or Alzheimer’s. We have too many toxins to sort it all out.

Research shows that wireless microwave radiation adds yet another dose of toxic exposure to our daily lives. We cannot hear it or smell it or feel it. Yet it affects our biology and our wellbeing with perhaps subtle affects. If we are electro-sensitive then we are more likely to avoid exposure. Trees are even susceptible to EMF harm and they cannot move away. (128) What about birds and bees and us?

Close Encounters: Google Glass, Virtual Reality and Wearable Wireless Devices

If we are concerned about putting a cell phone to our ears for long periods of time after reading about the NTP study then why aren’t we concerned about other wearable devices? While very cool to use Google Glass and Virtual Reality may have dangerous consequences to our eyes, brain function or immune systems with long term use, especially to children. What are the frequencies in these

devices? 3G,4G, 5G or a combination of zapping frequencies giving us immersive connection and entertainment but at a potentially steep price.

5G Research and Policy

Safety testing for 5G is the same as other wireless devices. It is based on heat. This is an obsolete standard and not considering current science showing cellular and organism harm from non-thermal effects. There is a large gap in safety data for 5G biological effects that has been demonstrated in older studies including military.

New Recommendations to Protect Public Health

- 1) Do not proceed to roll out 5G technologies pending pre-market studies on health effects**
- 2) Reevaluate safety standards based on long term as well as short term studies on biological effects**
- 3) Rescind a portion of Section 704 of the Telecommunications Act of 1996 which preempts state and local government regulation for the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects so that health and environmental issues can be addressed**
- 4) Rescind portions of The Spectrum Act which was passed in 2012 as part of the Middle Class Tax Relief and Job Creation Act, which strips the ability city officials and local governments to regulate cellular communications equipment, provides no public notification or opportunity for public input and may potentially result in environmental impacts**
- 5) Create an independent multidisciplinary scientific agency tasked with developing appropriate safety regulations, premarket testing and research needs in a transparent environment with public input**

6) Label pertinent EMF information on devices along with appropriate precautionary warnings.

References for:

A 5G Wireless Future: Will it give us a Smart Nation or contribute to an Unhealthy One?

1) **Project Skybender: Google's secretive 5G internet drone tests revealed.** The Guardian. Mark Harris. January 29, 2016.

<https://www.theguardian.com/technology/2016/jan/29/project-skybender-google-drone-tests-internet-spaceport-virgin-galactic>

2) **Acceleration of Broadband Deployment by Improving Wireless Facilities Siting Policies .** October 17,

2014. https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-153A1.pdf

3) **Use of Spectrum Bands Above 24 GHz For Mobile Radio Services.** October 22, 2015. https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-138A1.pdf

4) **5G Spectrum.**

http://www.4gamericas.org/files/6514/3930/9262/4G_Americas_5G_Spectrum_Recommendations_White_Paper.pdf

5) **FCC Comments. Ronald Powell, PhD.** Applied Physics Degree-Harvard University. August 31, 2013. <https://ecfsapi.fcc.gov/file/7520940670.pdf>

6) **Message to Schools and Colleges about Wireless Devices and Health.** Ronald Powell, PhD. Nov 24,

2015. <https://www.scribd.com/document/289778053/Message-to-Schools-and-Colleges-about-Wireless-Devices-and-Health>

7) **FCC Letter Opposition to Development of Spectrum Frontiers 5G.** Derek Bishop for Ronald Powell,

PhD. <https://www.fcc.gov/ecfs/filing/107132543307627>

8) **Small cells: Backhaul difficulties and a 5G future**

<http://www.rcrwireless.com/20160711/network-infrastructure/small-cells-tag31-tag99>

9) **Non-line-of-sight microwave backhaul for small cells.** https://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2013/er-nlos-microwave-backhaul.pdf

10) **Frequency Wavelength Chart- Henry Ott Consultants.** <http://www.hottconsultants.com/techtips/freq-wavelength.html>

11) **Convert Gigahertz to centimeter wavelengths.** http://www.translatorscafe.com/cafe/EN/units-converter/frequency-wavelength/5-29/gigahertz-wavelength_in_centimetres/

12) **What is 2 G Spectrum? Graph of Electromagnetic spectrum.** <https://www.quora.com/What-is-2G-spectrum>

13) **Electromagnetic radiation. U of Oregon.** http://abyss.uoregon.edu/~js/glossary/electromagnetic_radiation.html

14) **Bees Can Sense the Electric Fields of Flowers.** <http://phenomena.nationalgeographic.com/2013/02/21/bees-can-sense-the-electric-fields-of-flowers/>

15) **Detection and Learning of Floral Electric Fields by Bumblebees.** Clarke, Whitney, Sutton & Robert Science. <http://dx.doi.org/10.1126/science.1230883>

16) **Dolphin detects electric fields with ex-whisker pits.** <http://phenomena.nationalgeographic.com/2011/07/26/dolphin-detects-electric-fields-with-ex-whisker-pits/>

17) **The electromagnetic response of human skin in the millimetre and submillimetre wave range.** Feldman, Y. Phys Med Biol. 2009 Jun 7;54(11):3341-63. <https://www.ncbi.nlm.nih.gov/pubmed/?term=19430110>

18) **Human skin as arrays of helical antennas in the millimeter and submillimeter wave range.** Feldman, Y. Phys Rev Lett. 2008 Mar 28;100(12):128102 <https://www.ncbi.nlm.nih.gov/pubmed/18517913>

19) **Defense Intelligence Agency: Biological Effects of Electromagnetic Radiation (Radiowaves and Microwaves) in Eurasian Communist Countries.** October 10, 1975. Prepared by Army Medical Intelligence and the office of the

Surgeon General.

http://www.cqlpe.ca/pdf/BIOLOGICAL_EFFECTS_OF_ELECTROMAGNETIC_RADIATION.pdf

20) **Modeling of reflectometric and ellipsometric spectra from the skin in the terahertz and submillimeter waves region.** Ney, M. J Biomed Opt. 2011 Jun;16(6):067006. <https://www.ncbi.nlm.nih.gov/pubmed/21721827>

21) **Twenty Four-Hour Exposure to a 0.12 THz Electromagnetic Field Does Not Affect the Genotoxicity, Morphological Changes, or Expression of Heat Shock Protein in HCE-T Cells.** Int J Environ Res Public Health. 2016 Aug 5;13(8) . Koyama , S. <https://www.ncbi.nlm.nih.gov/pubmed/27527204>

22) **Terahertz radiation at 0.380 THz and 2.520 THz does not lead to DNA damage in skin cells in vitro.** Radiat Res. 2013 Jan;179(1):38-45 <https://www.ncbi.nlm.nih.gov/pubmed/23181591>

23) **Verizon and AT&T Prepare to Bring 5G to Market.** Dec 30, 2016. <http://spectrum.ieee.org/telecom/wireless/verizon-and-att-prepare-to-bring-5g-to-market>

24) **IEEE.org- Spectrum News Articles.** <http://spectrum.ieee.org/AugmentedReality:ForgettheGlasses>. Dec 29, 2016. <http://spectrum.ieee.org/consumer-electronics/gaming/augmented-reality-forget-the-glasses>

25) **Facebooks Face Recognition Tech Goes on Trial.** <http://spectrum.ieee.org/biomedical/imaging/facebook-faces-face-recognition-tech-goes-on-trial>

26) **Electronic Frontier Foundation.** <https://www.eff.org/>

27) **Saying kids were endangered, Uganda is closing schools backed by U.S., World Bank, Bill Gates and Mark Zuckerberg Charter Schools.** https://www.washingtonpost.com/news/answer-sheet/wp/2016/08/17/saying-kids-were-endangered-uganda-is-closing-schools-backed-by-u-s-world-bank-bill-gates-and-mark-zuckerberg/?utm_term=.31419cad3801

28) **Reactions of biological systems of various complexity to the action of low-level EHF radiation.** Chernyakov GM, Korochkin VL, Babenko AP, Bigdai EV (1989). In Devyatkov ND (ed): "Millimeter Waves in Medicine and Biology". Moscow: Radioelectronica, pp 141-167 (in Russian).

29) **FCC Docket FCC 15-138. Jan 26, 2016** https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-138A1_Rcd.pdf

30) **5G Spectrum Frontiers filings to FCC- Docket- 14-177.** https://www.fcc.gov/ecfs/search/filings?limit=25&offset=75&proceedings_name=14-177&sort=date_disseminated,DESC

31) **FCC filing docket 13-39. June 4, 2013- Info on reevaluation of safety standards and wifi in schools.** Sage-<https://ecfsapi.fcc.gov/file/7520941649.pdf>

32) **FCC Filing Bioinitiative summary on reevaluation of standards-** <https://ecfsapi.fcc.gov/file/7520939954.pdf>

33) **National Academies of Science, Engineering and Medicine. Report on Potential Health Effect of Wireless Communication Devices.**
<http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12036>

34) **[Evaluation of genotoxic and/or co-genotoxic effects in cells exposed in vitro to extremely-low frequency electromagnetic fields].** Scassellati Sforzolini. Ann Ig. 2004 Jan-Apr;16(1-2):321-40G<https://www.ncbi.nlm.nih.gov/pubmed/15554538>

35) **Effects of co-exposure to extremely low frequency (50 Hz) magnetic fields and xenobiotics determined in vitro by the alkaline comet assay.** Villarini M. Sci Total Environ. 2006 May 15;361(1-3):208-19. Sci Total Environ. 2006 May 15;361(1-3):208-19.

36) **Extremely low frequency magnetic fields cause oxidative DNA damage in rats.** Yokus B. Int J Radiat Biol. 2008 Oct;84(10):789-95.<https://www.ncbi.nlm.nih.gov/pubmed/18979312>

37) **Induction of micronuclei and superoxide production in neuroblastoma and glioma cell lines exposed to weak 50 Hz magnetic fields.** Kesari KK. J R Soc Interface. 2016 Jan;13(114) . <https://www.ncbi.nlm.nih.gov/pubmed/26791000>

38) Pre-exposure to 50 Hz magnetic fields modifies menadione-induced genotoxic effects in human SH-SY5Y neuroblastoma cells. Luukkonen J. PLoS One. 2011 Mar 23;6(3).

39) Animal studies on the role of 50/60-Hertz magnetic fields in carcinogenesis. Löscher W. Life Sci. 1994;54(21):1531-43.

40) Genomic instability induced by 50Hz magnetic fields is a dynamically evolving process not blocked by antioxidant treatment. Kesari KK. Mutat Res Genet Toxicol Environ Mutagen. 2015 Dec;794:46-51. <https://www.ncbi.nlm.nih.gov/pubmed/26653983>

41) Do electromagnetic fields enhance the effects of environmental carcinogens? Juutilainen J. Radiat Prot Dosimetry. 2008;132(2):228-31. <https://www.ncbi.nlm.nih.gov/pubmed/18977776>

42) FCC Filing 14-177. CITA- <https://www.fcc.gov/ecfs/filing/1025161301514>

43) FCC Filing 14-177- Satellite Industry Association. <https://www.fcc.gov/ecfs/filing/1003878007495/document/10038780074954070>

44) FCC Filing 14-177- Wi-Fi Alliance. <https://ecfsapi.fcc.gov/file/1093082983944/Wi-Fi%20Alliance%20Comments%20on%20Millimeter%20Wave%20FNPRM.pdf>

45) FCC letter- T Mobile- October 1, 2016. <https://www.fcc.gov/ecfs/filing/100105449239/document/100105449239a495>

46) FCC Filing 14-177 Facebook. Oct 1, 2016. <https://www.fcc.gov/ecfs/filing/10012127400524/document/1001212740052496aa>

47) FCC Filing 14-177 5G Americas- <https://www.fcc.gov/ecfs/filing/1093077796003/document/1093077796003462f>

48) **FCC Filing 14-177- Telecommunications Industry Association.** <https://www.fcc.gov/ecfs/filing/10930622009381/document/1093062200938116fe>

49) **UN Convention on the Rights of the Child. 1989.** <http://www.ohchr.org/en/professionalinterest/pages/crc.aspx>

50) **Western countries 1989-2010: Cause for concern.** Pritchard C. Surg Neurol Int. 2015 Jul 23;6:123. <https://www.ncbi.nlm.nih.gov/pubmed/?term=PMC4521226>

51) **European Manifesto in Support of European Citizens Initiative to Regulate EMF Exposure.** http://www.peccem.org/DocumentacionDescarga/Campanas/ICE2013/ENG_EUROPEAN_MANIFESTO_IN_SUPPORT_THE_ECI.pdf

52) **Letter to the Pope. The Church and the Urgent Protection of Life Against Electromagnetic Pollution.** July 2016. <http://www.peccem.org/DocumentacionDescarga/internacional/Letter.to.the.Pope.Francis.WYD.2016-EN.pdf>

53) **FCC Filing.** https://www.fcc.gov/ecfs/search/filings?limit=25&offset=0&proceedings_name=14-177&sort=date_disseminated,DESC

54) **FCC filings.** https://www.fcc.gov/ecfs/search/filings?limit=25&offset=0&proceedings_name=14-177&sort=date_disseminated,DESC

55) **FCC Filing 14-177.** https://www.fcc.gov/ecfs/search/filings?limit=25&offset=0&proceedings_name=14-177&sort=date_disseminated,DESC

56) **Mobile phones and vanishing birds-** <http://www.i-sis.org.uk/MPVB.php>

57) **Mobile Phones and Vanishing Bees-** <http://www.i-sis.org.uk/MobilePhonesVanishingBees.php>

58) **Bioeffects of microwave—a brief review.** S. Banik . Bioresource Technology 87 (2003) 155–

159. https://www.researchgate.net/profile/Dr_Shymal_Banik/publication/10745209_Bioeffects_of_microwave_-_A_brief_review/links/543f95d80cf27832ae8b8e41.pdf

59) **Efforts By The Environmental Protection Agency To Protect The Public From Environmental Nonionizing Radiation Exposures.** United States General Accounting Office. CED-78-79, 1978. <http://www.gao.gov/products/CED-78-79>

60) **International Association of Firefighters. Division of Occupational Health Safety and Medicine. Position on Health Effects from Radiofrequency/Microwave radiation in Fire Department Facilities from Base Stations for Antennas and Towers for the Conduction of Cell Phone Transmissions.** Adopted 2004. Firefighters stopped cell towers due to concerns of general health and neurologic symptoms. <http://www.iaff.org/hs/facts/CellTowerFinal.asp>

61) **Annual Wireless Industry Survey. CTIA. 2015.** <http://www.ctia.org/industry-data/ctia-annual-wireless-industry-survey>

62) **FCC- 5G Remarks of Chairman Wheeler on “The Future of Wireless” June 20, 2016.** <https://www.fcc.gov/document/remarks-chairman-wheeler-future-wireless>

63) **NASA Report - Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories.** April 1981. Jeremy Raines, PhD. <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19810017132.pdf>
<http://emfrefugee.blogspot.com/2014/04/nasa-emf-interactions-with-human-body.html>

64) **French companies will have to protect employees from electromagnetic waves. Jan 1, 2017.**
<https://www.legifrance.gouv.fr/eli/decret/2016/8/3/ETST1611714D/jo>
<https://www.franceinter.fr/societe/les-entreprises-vont-devoir-protoger-les-salaries-des-ondes-electromagnetiques>

65) **Differential sensitivity of developmental stages to low-level electromagnetic radiation of extremely ultrahigh frequency.** Belyaev IYa, Okladnova OV, Izmailov DM, Sheglov VS, Obukhova LK (1990). Dokl Akad Nauk SSSR [Ser B Geol Chim Biol] 12:68-70 (in Russian).

66) **Why You May Have Good Reason to Worry About All those Smart Devices.** Larry Downes. Washington Post. Dec 6, 2017. https://www.washingtonpost.com/news/innovations/wp/2016/12/06/why-you-may-have-good-reason-to-worry-about-all-those-smart-devices/?utm_term=.ba8722675d72

67) **"What's the Diagnosis Doctor?" Dr. Scott Eberle.** SCCMA Bulletin Nov 2016. <http://www.sccma-mcms.org/Portals/19/Whats%20the%20Diagnosis%20Doctor.pdf?ver=2016-12-09-152046-290>

68) **Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder.** Belpomme, D. Rev Environ Health. 2015;30(4):25-71. <https://www.ncbi.nlm.nih.gov/pubmed/26613326>

69) **Effects of low-intensity electromagnetic radiation in the millimeter range on the cardio-vascular system of the white rat.** Potekhina IL, Akoyev GN, Yenin LD, Oleyner VD (1992): Fiziol Zh [formerly Fiziol Zh SSSR] 78: 35-41 (in Russian).

70) **The Body Electric: Electromagnetism and the Foundation of Life.** Dr. Robert Becker. 1985. https://archive.org/stream/pdfy-uFS7t2QiFyjqB0sU/The%20Body%20Electric_djvu.txt

71) **Current State and Implications of Research on Biological Effects of Millimeter Waves: A Review of the Literature.** Andrei G. Pakhomov. Bioelectromagnetics 19:393–413 (1998) <http://www.rife.org/otherresearch/millimeterwaves.html>

72) **State of knowledge on biological effects at 40–60 GHz.** Yves Le Dréan, Yonis Soubere Mahamoud, Yann Le Page, Denis Habauzit, Catherine Le Quément, Maxim Zhadobov, Ronan Sauleau. State of knowledge on biological effects at 40–60 GHz. Comptes Rendus Physique, 14(5): 402-411. 2013. <http://fulltext.study/preview/pdf/1860108.pdf> <http://www.sciencedirect.com/science/article/pii/S1631070513000480>

73) **Transcriptome Analysis Reveals the Contribution of Thermal and the Specific Effects in Cellular Response to Millimeter Wave Exposure.** Oct. 14, 2014. PlosOne.Habauzit,

D. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4193780/> or <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0109435>

74) **Experimental studies on the influence of millimeter radiation on light transmission through the lens.** Prost, M. *Klin Oczna.* 1994 Aug-Sep;96(8-9):257-9. <https://www.ncbi.nlm.nih.gov/pubmed/7897988>

75) **The Human Body and Millimeter-Wave Wireless Communication Systems: Interactions and Implications.** T.Wu, T. S. Rappaport, C. M. Collins. 2015 IEEE International Conference on Communications (ICC), Jun. 2015.

76) **[Microwaves and the visual analyzer].** Zuev VG. *Aviakosm Ekolog Med.* 1992 Jul-Aug;26(4):4-8. <https://www.ncbi.nlm.nih.gov/pubmed/1296837>

77) **[Early ultrastructural reactions in various parts of the visual analyzer in guinea pigs after thermogenic microwave irradiation].** Ryzhov AI. *Arkh Anat Gistol Embriol.* 1991 Jul-Aug;100(7-8):30-6. <https://www.ncbi.nlm.nih.gov/pubmed/1843431>

78) **Visually evoked hemodynamical response and assessment of neurovascular coupling in the optic nerve and retina.** Riva CE. *Prog Retin Eye Res.* 2005 Mar;24(2):183-215. <https://www.ncbi.nlm.nih.gov/pubmed/15610973>

79) **Dosimetric study of microwave cataractogenesis.** Foster MR. *Bioelectromagnetics.* 1986;7(2):129-40. <https://www.ncbi.nlm.nih.gov/pubmed/3741488>

80) **Report of electromagnetic radiation surveys of video display terminals.** NIOSH. Moss, C.E. 1977
<https://www.cdc.gov/niosh/nioshtic-2/00081009.html>

81) **Radiation Emissions and Their Effects.** Radiation Effects of Video Display Terminals. 1983. <https://www.ncbi.nlm.nih.gov/books/NBK216487/>

82) **Cataracts and avionic radiations.** Zaret, MM. *Br J Ophthalmol.* 1977 Jun;61(6):380-4. <https://www.ncbi.nlm.nih.gov/pubmed/871464>

82) **NASA study of cataract in astronauts (NASCA). Report 1: Cross-sectional study of the relationship of exposure to space radiation and risk of lens**

opacity. Chylack LT. Radiat Res. 2009 Jul;172(1):10-20. <https://www.ncbi.nlm.nih.gov/pubmed/19580503>

83) **The impact of the new biology on radiation risks in space.** Dicello JF. Health Phys. 2003 Jul;85(1):94-102. <https://www.ncbi.nlm.nih.gov/pubmed/12861962>

84) **Electromagnetic Energy and Cataracts.** Dr. Milton Zaret. http://andrewamarino.com/PDFs/MB/MB_Ch24.pdf

85) **Industry Denies Health Threat : Explosion in Use of VDTs Spurs Regulation Debate.** LA Times. August 10, 1985. http://articles.latimes.com/1985-08-10/news/mn-3713_1_vdt-safety/4

86) **Safety of VDTs: Are They Really User-friendly?** Mary T. Schmich. July 21, 1985 http://articles.chicagotribune.com/1985-07-21/features/8502170510_1_vdt-workers-vdt-operators-tinker/2

87) **The strange case of Irving Selikoff.** Anthony Seaton. Occup Med (2010) 60 (1): 53. <https://academic.oup.com/occmed/article/60/1/53/1439563/The-strange-case-of-Irving-Selikoff>

88) **Science is not sufficient: Irving J. Selikoff and the asbestos tragedy.** McCulloch J. New Solut. 2007;17(4):293-310. <https://www.ncbi.nlm.nih.gov/pubmed/18184623>

89) **Shooting the messenger: the vilification of Irving J. Selikoff.** McCulloch J. Int J Health Serv. 2007;37(4):619-34. <https://www.ncbi.nlm.nih.gov/pubmed/18072311>

90) **Crown Castle plan for DAS in Palo Alto.** http://www.crowncastle.com/projects/palo-alto_ca.aspx

91) **City of Palo Alto Architectural Review Board meeting minutes 10/15/15. Summary Title: Crown Castle Downtown Wireless Project.** <https://www.cityofpaloalto.org/civicax/filebank/documents/49415>

92) **Architectural Review Board for DAS AT&T. City of Palo Alto. August 4, 2011.** <http://www.cityofpaloalto.org/civicax/filebank/documents/28220>

- 93) **Naval Medical Research Institute. 1971. Bibliography of Reported Biological Phenomena (“Effects”) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation.** Report No. 2 Revised. Zorach Glaser, PhD, Lt. MSC, USN. April 20th 1972.
http://www.justproveit.net/sites/default/files/prove-it/files/military_radiowave.pdf
- 94) **Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression.** Pall, M. Journal of Chemical Neuroanatomy. Volume 75, Part B, September 2016, Pages 43–51
<http://www.sciencedirect.com/science/article/pii/S0891061815000599>
sedat
- 95) **UCSF Letter from John Holdren to Assistant to the President for Science and Technology regarding airport scanners.** <http://www.npr.org/assets/news/2010/05/17/concern.pdf>
- 96) **The Internet Of Things Won't Be Big It'll Be Huge.** <http://www.forbes.com/sites/markpmills/2016/09/28/the-internet-of-things-wont-be-big-itll-be-huge/#70718ffb3a1c>
- 97) **What is a smart city?**
<http://smartcities.gov.in/writereaddata/What%20is%20Smart%20City.pdf>
- 98) **5G Future:** <https://www.youtube.com/watch?v=6-XWCJggMAo>
- 99) **Everything You Should Know About 5G!**
https://www.youtube.com/watch?v=ikR0_ptc4P4
- 100) **So, what's 5G exactly? Samsung**
https://www.youtube.com/watch?v=_GMMtMKYH2A
- 101) **Qualcomm Snapdragon 835 Unveil | CES 2017**
<https://www.youtube.com/watch?v=QvnaBT79gn0>
- 102) **Millimeter Waves Will Expand the Wireless Future.** <http://electronicdesign.com/communications/millimeter-waves-will-expand-wireless-future>
- 103) **How the microwave was invented by a radar engineer who accidentally cooked a candy bar in his pocket. July 3, 2015.**

<http://www.businessinsider.com/how-the-microwave-oven-was-invented-by-accident-2015-4>

104) Chronic Disease Prevention and Health promotion.

CDC. <https://www.cdc.gov/chronicdisease/>

105) MILKEN INSTITUTE STUDY: CHRONIC DISEASE COSTS U.S. ECONOMY MORE THAN \$1 TRILLION ANNUALLY.

<http://www.fightchronicdisease.org/latest-news/milken-institute-study-chronic-disease-costs-us-economy-more-1-trillion-annually>

106) Evolution and Earth's Electric Field.

<https://www.thunderbolts.info/wp/2015/10/08/evolution-and-earths-electric-field/>

107) A World Without Day or Night.

https://www.mpg.de/943613/S003_Flashback_060_061.pdf

108) The Origin and Evolution of Life. Tom Fenchel. Pg 23.

109) WHO 1981 Radiofrequency and Microwaves. Biologic Effects and Health Hazards of Microwave Radiation: Proceedings on International Symposium 1973. Warsaw, Oct 15-18, 1973. Sponsored by the WHO, US Department of Health, Education and Welfare, and The Scientific Council to the Minister of health and Social Welfare,

Poland. http://apps.who.int/iris/bitstream/10665/39107/1/9241540761_eng.pdf

110) Qualcomm's 5G preview: High frequencies, 5-gigabit speed.

<http://www.computerworld.com/article/3131842/mobile-wireless/qualcomms-5g-preview-high-frequencies-5-gigabit-speed.html>

111) How do Satellites communicate? NASA.

https://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/txt_satellite_comm.html

112) Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. Hardell

L. Int J Oncol. 2013 Dec;43(6):1833-

45. <http://www.ncbi.nlm.nih.gov/pubmed/24064953>

113) **Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones.** Hardell L. Int J Oncol. 2013 Oct;43(4):1036-44. <http://www.ncbi.nlm.nih.gov/pubmed/23877578>

114) **Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries.** Cardis E. Occup Environ Med. 2011 Sep;68(9):631-40. <http://www.ncbi.nlm.nih.gov/pubmed/21659469>

115) **Mobile phone use and risk of tumors: a meta-analysis.** Myung SK, Moskowitz JM. J Clin Oncol. 2009 Nov 20;27(33):5565-72. <http://www.ncbi.nlm.nih.gov/pubmed/?term=cell+phones+brain+cancer+joeel+moskowitiz>

116) **Pooled analysis of two Swedish case-control studies on the use of mobile and cordless telephones and the risk of brain tumours diagnosed during 1997-2003.** Mild KH, Hardell L. Int J Occup Saf Ergon. 2007;13(1):63-71. <http://www.ncbi.nlm.nih.gov/pubmed/17362659>

117) **Long-term use of cellular phones and brain tumours: increased risk associated with use for > or =10 years.** Hardell L. Occup Environ Med. 2007 Sep;64(9):626-32. <http://www.ncbi.nlm.nih.gov/pubmed/17409179>

118) **Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003.** Hardell L. Neuroepidemiology. 2005;25(3):120-8. <http://www.ncbi.nlm.nih.gov/pubmed/15956809>

119) **Biological effects of electromagnetic fields.** Adey, WR . J Cell Biochem. 1993 Apr;51(4):410-6. <https://www.ncbi.nlm.nih.gov/pubmed/8388394>

120) **Skin heating effects of millimeter- wave irradiation-Thermal modeling results.** Nelson, D. A., M. T. Nelson, T. J. Walters, and P. A. Mason. IEEE Transactions on Microwave Theory and Techniques 48:2111-2120, 2000. <http://ieeexplore.ieee.org/document/884202/>

121) **Heating and pain sensation produced in human skin by millimeter waves: comparison to a simple thermal model.** Walters, T. J., D. W. Blick, L. R. Johnson, E. R. Adair, and K. R. Foster. Health Physics 78:259- 267, 2000. <https://www.ncbi.nlm.nih.gov/pubmed/10688448>

122) **Comparison of blood pressure and thermal responses in rats exposed to millimeter wave energy or environmental heat.** Millenbaugh NJ. Shock. 2006 Jun;25(6):625-32. <https://www.ncbi.nlm.nih.gov/pubmed/16721271>

123) **Current State and Implications of Research on Biological Effects of Millimeter Waves: A Review of the Literature.** Andrei G. Pakhomov. Bioelectromagnetics 19:393–413 (1998). <http://www.rife.org/otherresearch/millimeterwaves.html>

124) **National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley SD Rats (Whole Body Exposure).** 2016. <http://dx.doi.org/10.1101/055699>.

125) **National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation.** May 2016. <https://ntp.niehs.nih.gov/results/areas/cellphones/>

126) **Major Cell Phone Radiation Study Reignites Cancer Questions. Scientific America.** May 2016. <https://www.scientificamerican.com/article/major-cell-phone-radiation-study-reignites-cancer-questions/>

127) **Ron Melnick PhD Commentary on the National Toxicology Program Radiofrequency and Cancer Study.** <http://ehtrust.org/ron-melnick-phd-commentary-national-toxicology-program-radiofrequency-cancer-study/>

128) **Radiofrequency radiation injures trees around mobile phone base stations.** Waldmann-Selsam C. Sci Total Environ. 2016 Dec 1;572:554-569 <https://www.ncbi.nlm.nih.gov/pubmed/27552133>.

130) **Increased sensitivity of the non-human primate eye to microwave radiation following ophthalmic drug pretreatment.** Kues HA. Bioelectromagnetics. 1992;13(5):379-93 <https://www.ncbi.nlm.nih.gov/pubmed/1445419>

131) **[Suppression of nonspecific resistance of the body under the effect of extremely high frequency electromagnetic radiation of low intensity].** Kolomytseva MP. Biofizika. 2002 Jan-Feb;47(1):71-7. <https://www.ncbi.nlm.nih.gov/pubmed/11855293>

132) **Effects of low-intensity extremely high frequency electromagnetic radiation on chromatin structure of lymphoid cells in vivo and in vitro**. Gapeev AB. *Radiats Biol Radioecol*. 2003 Jan-Feb;43(1):87-92. <https://www.ncbi.nlm.nih.gov/pubmed/12677665>

133) **Low power density microwave radiation induced early changes in rabbit lens epithelial cells**. Ye, J. *Chin Med J (Engl)*. 2001 Dec;114(12):1290-4. *Chin Med J (Engl)*. 2001 Dec;114(12):1290-4. <https://www.ncbi.nlm.nih.gov/pubmed/11793856>

134) **Effect of millimeter-band radiation of nonthermal intensity on the sensitivity of staphylococcus to various antibiotics**. Bulgakova VG, Grushina VA, Orlova TI, Petrykina ZM, Polin AN, Noks PP, Kononenko AA, Rubin AB (1996). *Biofizika* 41:1289-1293 (in Russian). <https://www.ncbi.nlm.nih.gov/pubmed/9044624>

135) Adey, WR. 1993. **Biological Effects of Electromagnetic Fields**. *Journal of Cellular Biochemistry* 51:410-416.

136) **The Big Disconnect**. Catherine Steiner-Adair. Published 2013.

137) **The role of electromagnetic fields in neurological disorders**. *Journal of Chemical Neuroanatomy*. Terzi, M, Ozberk, B, Deniz, OG, Kaplan, S. Available online 12 April 2016. <http://1.usa.gov/1SVOa2g>

138) **Gray matter abnormalities in Internet addiction: a voxel-based morphometry study**. Zhou, Y. *Eur J Radiol*. 2011 Jul;79(1):92-5. <https://www.ncbi.nlm.nih.gov/pubmed/19926237>

139) **BioInitiative Working Group**, Cindy Sage and David O. Carpenter, Editors. *BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Radiation* at www.bioinitiative.org, December 31, 2012



June 22, 2017

Assembly Member Cecilia M. Aguiar-Curry
Chair of the Local Government Committee
1020 N Street, Room 157
Sacramento, California 95814

RE: SB 649

Dear Assembly Member Aguiar-Curry:

I am writing in opposition to SB 649 which will deny the public's right to participate in local decisions. The public has a constitutional right to protect our homes, our privacy, our health and the health of our children from RF radiation which soon will be in the form of 5G millimeter waves.

5G, the technology for which these small cells are a foundational part of the infrastructure, has not been tested on humans. On June 20, 2016 then-outgoing FCC Chairman Tom Wheeler announced at the Washington Press Club that 5G "redefines network connectivity for years to come." When asked by a Bloomberg reporter about health concerns, Chairman Wheeler replied the FCC did not have time to study health because the infrastructure for 5G will "generate tens of billions of dollars in economic activity." In short, 5G is a moneymaker. That concept is driving this bill and it is simply wrong. Not only is it wrong, but it is dangerous, and we need to listen to the firefighters before approving a bill from which there is no viable return.

SB 649 states: "the impact on local interests from individual small wireless facilities will be sufficiently minor." I disagree. The Bill was written by the industry, for the industry. It fails the consumer. It particularly fails the unborn, children, those with immune suppression, the infirm, the disabled, and the elderly. This technology has the capacity to completely disable sensitive segments of the population. It has the ability to inhibit repair of DNA, an essential component to our survival. An increasing number of studies show it has the ability to break DNA outright.

From a neurological and immunological perspective, RF (wireless) radiation has the power to interfere with how we think, how we behave, how we feel. It affects the Central Nervous System (the brain), and it affects our immune system. Those two systems overlap more than any other bodily systems, and thus if one is adversely affected, the other may be, as well. Many people are rendered EHS or "electro-hypersensitive" after continuous exposure to WiFi, cell towers, or cell phone exposure. This is particularly true if the exposure is 24/7, which small cells would be.

Over 15 years ago California did a survey and determined as many as 7% of its population was EHS or electro-hypersensitive, e.g. they have adverse reactions sometimes hours after exposure to wireless such as headache, cognitive impairment, inability to sleep, inability to stay awake, tinnitus, depression, or inability to focus. Conservative estimates in Europe and the US put the number at 3% with respect to EHS in a given population. Some studies show 11% as a more current reflection of EHS. In 2015 the US Census Bureau put the population of California at 39.14 million. Assuming the more conservative 3%, that translates to over 11.7 million Californians who must seek relief from wireless exposure for medical reasons.

Because 5G (for which SB 649 was requested by industry) is designed to penetrate walls with a focused, amplified beam there will be no safe haven, thus leaving California without a low cost prudent avoidance policy for those who are disabled from EMF exposure. Many of these small cells will be directly outside the homes and work places of individuals who are EHS.

Furthermore, there is virtually no oversight with respect to our existing RF exposure to 2G, 3G and 4G, and none is written into the bill to monitor or in any way assess the health impact of 5G. This bill will instantly make life more difficult for the 11 million-plus people who are EHS to find refuge from wireless. In fact, it will make it virtually impossible because 5G on small cell antenna can penetrate any wall, any barrier. That is what 5G is designed to do. This will be in direct violation of the Americans with Disabilities Act.

Additionally, health care costs for California will rise with this massive build out of infrastructure resulting in an exponential increase in radiation exposure not just at work and at school, but at home.

This bill is being rushed to passage, and there is a failure on the part of the bill's sponsors to take the potential health impact into consideration. It is up to you all as legislators to pause and consider the implications of what you are doing. Somehow people have come to believe wireless is like oxygen. We need it to survive. The truth is the exact opposite is true. When did anyone ever think microwave radiation was safe? Yes, this is microwave radiation. RF radiation is a euphemism. It is window-dressing. This technology is *not* safe.

I am far from alone in voicing this opinion. Just look at the firefighters. They are very well aware of the dangers as firestations were among the first commercial spaces targeted for cell tower placement, and the firefighters have lived with this exposure 24/7 for years. **The firefighters oppose SB 649 due to health concerns and have been granted an exemption for their stations.** I concur with the exemption for the firefighters.

As an Honorary Firefighters for the San Diego Fire Department, as the organizer of the only SPECT brain scan study of firefighters in California or anywhere in the US and Canada, as the original author of Res. 15 to call for a moratorium on the placement of cell towers throughout the US and Canada (2003), as a US Adviser to the Radiation Research Trust, and as a medical writer I can assure you that the language of your bill suggesting a "minor" impact is dangerously wrong. I am far from alone. 122 cities throughout California officially oppose SB 649. In addition, to date, 12 counties and myriad organizations oppose this bill.

I have worked with firefighters for over 15 years. My focus has been testing and educating firefighters about the neurological effects of RF radiation, yet the carcinogenic effects are deeply disturbing, as well. Brain cancer is now one of the leading cancers among firefighters and is considered a presumptive cancer in many states. Bottom line: Cell towers have made firefighters ill, impaired their ability to work and protect the public, and may have contributed to deaths.

On February 23, 2013 under WT Docket No. 12-357 I filed my comments with the FCC detailing the findings of a 2004 brain study I organized in which Dr. Gunnar Heuser and Dr. J. Michael Uszler of Santa Monica, CA conducted a pilot study of six (6) California firefighters who had been exposed to a cell tower 9' from their station for five years. These men had become ill – some within minutes, some within hours – after activation of the cell tower next to their station *in spite of months of reassurances from the industry that there were no ill effects from the towers*. The men were experiencing profound neurological symptoms.

The symptoms experienced by the firefighters, all of whom had passed rigorous physical and cognitive exams prior to being hired by the fire department, included but were not limited to the following: headaches, extreme fatigue, sleep disruption, anesthesia-like sleep where the men woke up for 911 calls “as if they were drugged”, inability to sleep, depression, anxiety, unexplained anger, getting lost on 911 calls in the town they grew up in, a twenty (20) year medic forgetting basic CPR in the midst of resuscitating a coronary victim, and immune-suppression manifest in frequent colds and flu-like symptoms.

All six (6) firefighters were found to have brain abnormalities on SPECT scan [single-photon emission computed tomography]. The doctors thought they would find areas of limited function in the brain based on the symptomatology. Instead, they found a pervasive, hyper-excitability of the neurons which suggested the exposure to RF (microwave) radiation was causing the neurons to continually fire without benefit of rest. RF radiation appeared to act as a constant stimulant even when the men were away from the station and in repose. The SPECT scans were considered abnormal in all six firefighters.

Cognitive function, reaction time, and impulse control were measured objectively using T.O.V.A. testing [Test of Variables of Attention]. In all six (6) firefighters, impairment was found with cognitive function, reaction time and impulse control. Three (3) of the six (6) firefighters were captains. The captain on each shift is in charge of making life altering decisions for all firefighters and potential victims. They order firefighters into a burning building, and conversely, they order them out before a roof may collapse, for example. Impairment of all three critical functions could cost firefighters and the community they serve either life or limb.

The testing was conducted in 2004. The cell towers were in place at the two (2) fire stations where the test subjects work for the duration of a twenty-two (22) year lease. The men we tested have remained at the stations as this is the only work they know in the only community they have ever lived in. One (1) of the six (6) men tested did move to another department after his wife gave birth to a boy who was diagnosed with Autism at age 2. This was the first live birth experienced by the “firefighter family” at this department since activation of the tower three (3) years earlier.

What is particularly germane to the critical decisions you are currently facing with SB 649 has to do with the industry line that the radiation from these small cells will be well under the safety guidelines set by the FCC. The FCC currently allows 1,000 microwatts per centimeter squared (uW/cm²) as an emission standard from cell towers. Yet all the symptoms attributed by the firefighters, as well as measurable brain and central nervous system abnormalities described above, occurred within close proximity to a cell tower measured at between 1 - 2 uW/cm² by Peter Sierck, BBEC, CEO of Environmental Testing & Technology in Encinitas, CA. **Thus the emissions from towers were measured at approximately 1/1000th to 1/500th of the FCC's allowable limit.** "Hot spots" of reflected radiation were measured at 15 and 30 uW/cm², yet these "hot spots" were still a fraction of what the FCC allows. Therefore, I strongly suggest **the FCC is not basing its standards on biological effects, but rather physics, and principles of physics do not protect the brains and central nervous systems of even the strongest among us -- our firefighters.** Please see my FCC filing at <https://ecfsapi.fcc.gov/file/7022117660.pdf>

You know the gist of this, or you would not have granted an exemption for firefighters from SB 649. In fact, Section 65964.2 specifically states small cells will not be located on a fire department facility. I know the firefighters asked for and received this exemption based on their concerns about adverse health effects from cell towers on or near their stations.

I know this exemption would not have been granted had you not believed that firefighters were at risk. And if firefighters, the strongest of the strong among us, are experiencing symptoms that impair their work performance due to severe headache, disorientation, sleep disturbance, cognitive impairment, delayed reaction time, lack of impulse control and mood swings, that begs the obvious question: What about the rest of us?

I implore you to see this bill for what it is. It is industry's gift to industry carried out by well-intentioned senators and assembly members who think they are doing what is best for their constituents. The "best" is to deny this carte blanche blanketing of small cells without local control.

Listen to the firefighters, and understand these brave men and women speak for all of us. If they are concerned about harm to their health, then we should be as well.

Respectfully Submitted,

Susan Foster

/s/ Susan Foster

Susan Foster *for the* RADIATION RESEARCH TRUST
US Adviser
Honorary Firefighter, San Diego Fire Department
Medical Writer
Rancho Santa Fe, CA 92091
susan.foster04@gmail.com

cc: dixie.petty@asm.ca.gov
nidia.bautista@sen.ca.gov
lilia.stone@asm.ca.gov
lily.movsisyan@asm.ca.gov
cody.storm@asm.ca.gov
nardos.girma@asm.ca.gov
jovan.agee@asm.ca.gov
laurel.brodzinsky@asm.ca.gov
steven.stenzler@asm.ca.gov
enedina.garcia@asm.ca.gov



Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine
9500 Gilman Drive, #0995
La Jolla, CA 92093-0995
Phone: 858 558-4950 x201

August 18, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.

My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person. As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect, see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes^{1,21}, and via these mechanisms, an impaired “blood brain barrier”³⁻⁵ (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema⁶), constriction of blood vessels and impaired blood flow to the brain⁷, and triggering of autoimmune reactions^{8,9}. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience “symptoms” that “merely” cause them distress and suffering, when they are exposed – symptoms like headaches^{10,11}, ringing ears^{10,11} and chest pain¹⁰ from impaired blood flow, heart rhythm abnormalities^{10,11}, and inability to sleep^{10,11}. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures¹¹, heart failure, hearing loss¹²⁻¹⁴ and severe cognitive impairment^{11,15}**. The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer’s disease¹⁶.



Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called “EMF refugees”¹⁷⁻¹⁹. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society – will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization²⁰; Matti Niemela, former Nokia Technology chief²¹; as well as the wife of Frank Clegg²², who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology²³.

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF).- particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn’t give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition^{24, 25}.

The role for oxidative stress, that has been shown in innumerable studies (below), **is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses,** that are less avid in defending against oxidative stress³⁰⁷. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine²⁶, regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, “This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies.”²⁷. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of protection by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them.** They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed*, in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an



exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.

(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)

Luckily, no abridgment of individual rights and freedoms is required to protect, here.

If any group can opt out (such as, I understand, firefighters*)²⁸; **then every group deserves that equal right.** Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have by the time she is a fetus in utero), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.



Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
 Professor of Medicine
 UC San Diego School of Medicine

*Comment on the fire fighter exemption: “The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. ... Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn’t recall how to start the procedure over again... Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (<https://ecfsapi.fcc.gov/file/7022117660.pdf>). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada.”^{15 28}
 Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at levels^{29,30} below those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants^{3, 7, 31-49}. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase “oxidative stress” (free radical injury) and damage mitochondria, the energy producing parts of cells^{1, 2, 34, 50-6930, 70-104105-13646, 137-171}. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These



mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures¹⁷²⁻¹⁷⁶, heart failure¹⁷⁷⁻¹⁸⁴ and cognitive decline^{5, 32, 57, 108, 185-195}.

These mechanisms have known involvement in induction of brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions, conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation^{8, 9, 16, 34, 196-219}.

Such radiation also has effects on sperm^{33, 100, 220-228}; and the DNA of sperm²²⁹ (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy²³⁰, to the fetus and subsequent offspring²³¹⁻²³⁵ including at low levels²³⁶, and is tied to developmental problems in later life, including attention deficit and hyperactivity^{31, 235-241}. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin^{40, 72, 242-252}, which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals^{10, 11}).

Melatonin is in fact a critical antioxidant that defends the body against harm from many toxic exposures²⁵³⁻²⁶⁶ including electromagnetic radiation itself^{61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284} - reducing the oxidative stress that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke^{9, 285-329330-343}.

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase^{81, 102, 115, 116, 233, 344-358} - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported^{359, 360}.



References.

1. Benderitter M, Vincent-Genod L, Pouget JP, Voisin P. The cell membrane as a biosensor of oxidative stress induced by radiation exposure: a multiparameter investigation. *Radiat Res* 2003;159:471-83.
2. Baureus Koch CL, Sommarin M, Persson BR, Salford LG, Eberhardt JL. Interaction between weak low frequency magnetic fields and cell membranes. *Bioelectromagnetics* 2003;24:395-402.
3. Tang J, Zhang Y, Yang L, et al. Exposure to 900 MHz electromagnetic fields activates the mcp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. *Brain Res* 2015;1601:92-101.
4. Nittby H, Brun A, Eberhardt J, Malmgren L, Persson BR, Salford LG. Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone. *Pathophysiology* 2009;16:103-12.
5. Zhang. Exposure to 900 MHz electromagnetic fields activates the mcp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. *Brain Res* 2015;1609:92-101.
6. Adair JC, Baldwin N, Kornfeld M, Rosenberg GA. Radiation-induced blood-brain barrier damage in astrocytoma: relation to elevated gelatinase B and urokinase. *J Neurooncol* 1999;44:283-9.
7. Aalto S, Haarala C, Bruck A, Sipila H, Hamalainen H, Rinne JO. Mobile phone affects cerebral blood flow in humans. *J Cereb Blood Flow Metab* 2006;26:885-90.
8. Ivanov AA, Grigor'ev lu G, Mal'tsev VN, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 3. The effect of the long-term non-thermal RF EMF exposure on complement-fixation antibodies against homogenous tissue]. *Radiats Biol Radioecol* 2010;50:17-21.
9. Grigor'ev lu G, Mikhailov VF, Ivanov AA, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 4. Manifestation of oxidative intracellular stress-reaction after long-term non-thermal EMF exposure of rats]. *Radiats Biol Radioecol* 2010;50:22-7.
10. Lamech F. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in victoria, australia: a case series. *Altern Ther Health Med* 2014;20:28-39.
11. Halteman E. Wireless utility meter safety impacts survey: Final Results Summary. Sept 13 2011;(<http://emfsafetynetwork.org/wp-content/uploads/2011/09/Wireless-Utility-Meter-Safety-Impacts-Survey-Results-Final.pdf>). 97.
12. Alsanosi AA, Al-Momani MO, Hagr AA, Almomani FM, Shami IM, Al-Habeeb SF. The acute auditory effects of exposure for 60 minutes to mobile's electromagnetic field. *Saudi Med J* 2013;34:142-6.
13. Karaer I, Simsek G, Gul M, et al. Melatonin protects inner ear against radiation damage in rats. *Laryngoscope* 2015.
14. Celiker H, Ozgur A, Tumkaya L, et al. Effects of exposure to 2100MHz GSM-like radiofrequency electromagnetic field on auditory system of rats. *Braz Otorhinolaryngol* 2016;S1808-8694:302221.
15. Foster S. Health exemption for firefighters sends a message to the world. *GALLERY*;Posted on June 26, 2017.
16. Sobel E, Davanipour Z, Sulkava R, et al. Occupations with exposure to EMFs: a possible link for Alzheimer's disease. *Amer J Epidemiol* 1995;142:515-24.



17. Stein Y. Environmental refugees. UNESCO 10th World Conference on ZBioethics, Medical Ethics and Health Law 2015;Jerusalem, Israel:Jan 6-8.
18. Frompovich CJ. Environmental refugees: Electromagnetic hypersensitivity (EHS) sufferers. Naturalblazecom 2016;Jan 28.
19. <http://www.emfanalysis.com/emf-refugee/>.
20. [;http://articles.latimes.com/2010/feb/15/health/la-he-electromagnetic-syndrome1-2010feb15](http://articles.latimes.com/2010/feb/15/health/la-he-electromagnetic-syndrome1-2010feb15).
21. <http://stopsmartmetersorguk/former-nokia-chief-mobile-phones-wrecked-my-health/>.
22. [;http://www.huffingtonpost.ca/frank-clegg/post_5393_b_3745157.html](http://www.huffingtonpost.ca/frank-clegg/post_5393_b_3745157.html).
23. Clegg F. Electrohypersensitivity Is Real. The Huffington Post, Canada 2013;June 12, 2013.
24. Belpomme D, Campagnac C, Irigaray P. Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. Rev Environ Health 2015;30:251-71.
25. Heuser G, Heuser SA. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. . Rev Environ Health 2017;Jul 5.
26. Golomb BA. Conflict of Interest in Medicine
<http://thesciencenetwork.org/programs/beyond-belief-candles-in-the-dark/beatrice-golomb>: Beyond Belief: Candles in the Dark, sponsored by The Science Network (tsntv.org), session entitled "This is Your Brain on Politics" Salk Institute. La Jolla, CA. Oct 5; 2008.
27. Smith R. Conflicts of interest: how money clouds objectivity. J R Soc Med 2006;99:292-7.
28. International Association of Fire Fighters Division of Occupational Health SaM. Position on the health effects from radio frequency/ microwave (RF/MW) radiation in fire department facilities from base stations for antennas and towers for the conduction of cell phone transmissions. 2006.
29. Gurler HS, Bilgici B, Akar AK, Tomak L, Bedir A. Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic. Int J Radiat Biol 2014;90:892-6.
30. Jajte J, Zmyslony M. [The role of melatonin in the molecular mechanism of weak, static and extremely low frequency (50 Hz) magnetic fields (ELF)]. Med Pr 2000;51:51-7.
31. Hardell L, Sage C. Biological effects from electromagnetic field exposure and public exposure standards. Biomed Pharmacother 2008;62:104-9.
32. Deshmukh PS, Nasare N, Megha K, et al. Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. Int J Toxicol 2015;34:284-90.
33. Avendano C, Mata A, Sanchez Sarmiento CA, Doncel GF. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. Fertil Steril 2012;97:39-45 e2.
34. Barnes F, Greenenbaum B. Some Effects of Weak Magnetic Fields on Biological Systems: RF fields can change radical concentrations and cancer cell growth rates. IEEE Power Electronics Magazine 2016;3:60-8.
35. Blank M, Goodman R. Comment: a biological guide for electromagnetic safety: the stress response. Bioelectromagnetics 2004;25:642-6; discussion 7-8.



36. Burlaka A, Selyuk M, Gafurov M, Lukin S, Potaskalova V, Sidorik E. Changes in mitochondrial functioning with electromagnetic radiation of ultra high frequency as revealed by electron paramagnetic resonance methodsX. *Int J Radiat Biol* 2014;90:357-62.
37. Derias EM, Stefanis P, Drakeley A, Gazvani R, Lewis-Jones DI. Growing concern over the safety of using mobile phones and male fertility {THERMAL + NONTHERMAL}. *Arch Androl* 2006;52:9-14.
38. Diem E, Schwarz C, Adlkofer F, Jahn O, Rudiger H. Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. *Mutat Res* 2005;583:178-83.
39. Ferreira AR, Knakievicz T, Pasquali MA, et al. Ultra high frequency-electromagnetic field irradiation during pregnancy leads to an increase in erythrocytes micronuclei incidence in rat offspring. *Life Sci* 2006;80:43-50.
40. Halgamuge MN. Pineal melatonin level disruption in humans due to electromagnetic fields and ICNIRP limits. *Radiat Prot Dosimetry* 2013;154:405-16.
41. Mancinelli F, Caraglia M, Abbruzzese A, d'Ambrosio G, Massa R, Bismuto E. Non-thermal effects of electromagnetic fields at mobile phone frequency on the refolding of an intracellular protein: myoglobin. *J Cell Biochem* 2004;93:188-96.
42. Lai H. Research on the neurological effects of nonionizing radiation at the University of Washington. *Bioelectromagnetics* 1992;13:513-26.
43. Lerchl A, Kruger H, Niehaus M, Streckert JR, Bitz AK, Hansen V. Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (*Phodopus sungorus*) - BODY WT CHG. *J Pineal Res* 2008;44:267-72.
44. Leszczynski D, Joenvaara S, Reivinen J, Kuokka R. Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects. *Differentiation* 2002;70:120-9.
45. Lixia S, Yao K, Kaijun W, et al. Effects of 1.8 GHz radiofrequency field on DNA damage and expression of heat shock protein 70 in human lens epithelial cells. *Mutat Res* 2006;602:135-42.
46. Sahin D, Ozgur E, Guler G, et al. The 2100MHz radiofrequency radiation of a 3G-mobile phone and the DNA oxidative damage in brain. *J Chem Neuroanat* 2016;75:94-8.
47. Song JM, Milligan JR, Sutherland BM. Bistranded oxidized purine damage clusters: induced in DNA by long-wavelength ultraviolet (290-400 nm) radiation? *Biochemistry* 2002;41:8683-8.
48. Yurekli AI, Ozkan M, Kalkan T, et al. GSM base station electromagnetic radiation and oxidative stress in rats. *Electromagn Biol Med* 2006;25:177-88.
49. Tafforeau M, Verdus MC, Norris V, et al. Plant sensitivity to low intensity 105 GHz electromagnetic radiation. *Bioelectromagnetics* 2004;25:403-7.
50. Ciejka E, Jakubowska E, Zelechowska P, Huk-Kolega H, Kowalczyk A, Goraca A. [Effect of extremely low frequency magnetic field on glutathione in rat muscles]. *Med Pr* 2014;65:343-9.
51. Consales C, Merla C, Marino C, Benassi B. Electromagnetic fields, oxidative stress, and neurodegeneration. *Int J Cell Biol* 2012;2012:683897.
52. Copeland ES. Production of free radicals in reduced glutathione and penicillamine by thermal hydrogen atoms and X-radiation. *Int J Radiat Biol Relat Stud Phys Chem Med* 1969;16:113-20.



53. Cravotto G, Binello A, Di Carlo S, Orio L, Wu ZL, Ondruschka B. Oxidative degradation of chlorophenol derivatives promoted by microwaves or power ultrasound: a mechanism investigation. *Environ Sci Pollut Res Int* 2010;17:674-87.
54. Crouzier D, Perrin A, Torres G, Dabouis V, Debouzy JC. Pulsed electromagnetic field at 9.71 GHz increase free radical production in yeast (*Saccharomyces cerevisiae*). *Pathol Biol (Paris)* 2009;57:245-51.
55. de Moraes Ramos FM, Schonlau F, Novaes PD, Manzi FR, Boscolo FN, de Almeida SM. Pycnogenol protects against ionizing radiation as shown in the intestinal mucosa of rats exposed to X-rays. *Phytother Res* 2006;20:676-9.
56. Devi PU, Ganasoundari A. Modulation of glutathione and antioxidant enzymes by *Ocimum sanctum* and its role in protection against radiation injury. *Indian J Exp Biol* 1999;37:262-8.
57. Deshmukh PS, Banerjee BD, Abegaonkar MP, et al. Effect of low level microwave radiation exposure on cognitive function and oxidative stress in rats. *Indian J Biochem Biophys* 2013;50:114-9.
58. Dimri M, Joshi J, Chakrabarti R, Sehgal N, Sureshababu A, Kumar IP. Todralazine protects zebrafish from lethal effects of ionizing radiation: role of hematopoietic cell expansion. *Zebrafish* 2015;12:33-47.
59. Dimri M, Joshi J, Shrivastava N, Ghosh S, Chakraborti R, Indracanti PK. Prilocaine hydrochloride protects zebrafish from lethal effects of ionizing radiation: role of hematopoietic cell expansion. *Tokai J Exp Clin Med* 2015;40:8-15.
60. Durovic B, Spasic-Jokic V. Influence of occupational exposure to low-dose ionizing radiation on the plasma activity of superoxide dismutase and glutathione level. *Vojnosanit Pregl* 2008;65:613-8.
61. El-Missiry MA, Fayed TA, El-Sawy MR, El-Sayed AA. Ameliorative effect of melatonin against gamma-irradiation-induced oxidative stress and tissue injury. *Ecotoxicol Environ Saf* 2007;66:278-86.
62. Falone S, Mirabilio A, Carbone MC, et al. Chronic exposure to 50Hz magnetic fields causes a significant weakening of antioxidant defence systems in aged rat brain. *Int J Biochem Cell Biol* 2008;40:2762-70.
63. Fitzgerald MP, Madsen JM, Coleman MC, et al. Transgenic biosynthesis of trypanothione protects *Escherichia coli* from radiation-induced toxicity. *Radiat Res* 2010;174:290-6.
64. Giannopoulou E, Katsoris P, Parthymou A, Kardamakis D, Papadimitriou E. Amifostine protects blood vessels from the effects of ionizing radiation. *Anticancer Res* 2002;22:2821-6.
65. Goraca A, Ciejka E, Piechota A. Effects of extremely low frequency magnetic field on the parameters of oxidative stress in heart. *J Physiol Pharmacol* 2010;61:333-8.
66. Goswami S, Haldar C. UVB irradiation severely induces systemic tissue injury by augmenting oxidative load in a tropical rodent: efficacy of melatonin as an antioxidant. *J Photochem Photobiol B* 2014;141:84-92.
67. Goswami S, Sharma S, Haldar C. The oxidative damages caused by ultraviolet radiation type C (UVC) to a tropical rodent *Funambulus pennanti*: role of melatonin. *J Photochem Photobiol B* 2013;125:19-25.
68. Groen HJ, Meijer C, De Vries EG, Mulder NH. Red blood cell glutathione levels in lung cancer patients treated by radiation and continuously infused carboplatin. *Anticancer Res* 1996;16:1033-7.
69. Guler G, Seyhan N, Aricioglu A. Effects of static and 50 Hz alternating electric fields on superoxide dismutase activity and TBARS levels in guinea pigs. *Gen Physiol Biophys* 2006;25:177-93.
70. Guler G, Turkozer Z, Tomruk A, Seyhan N. The protective effects of N-acetyl-L-cysteine and epigallocatechin-3-gallate on electric field-induced hepatic oxidative stress. *Int J Radiat Biol* 2008;84:669-80.



71. Gultekin FA, Bakkal BH, Guven B, et al. Effects of ozone oxidative preconditioning on radiation-induced organ damage in rats. *J Radiat Res* 2013;54:36-44.
72. Halgamuge MN. Critical time delay of the pineal melatonin rhythm in humans due to weak electromagnetic exposure. *Indian J Biochem Biophys* 2013;50:259-65.
73. Irmak MK, Fadillioglu E, Gulec M, Erdogan H, Yagmurca M, Akyol O. Effects of electromagnetic radiation from a cellular telephone on the oxidant and antioxidant levels in rabbits. *Cell Biochem Funct* 2002;20:279-83.
74. Jagetia G, Baliga M, Venkatesh P. Ginger (*Zingiber officinale* Rosc.), a dietary supplement, protects mice against radiation-induced lethality: mechanism of action. *Cancer Biother Radiopharm* 2004;19:422-35.
75. Jagetia GC, Malagi KJ, Baliga MS, Venkatesh P, Veruva RR. Triphala, an ayurvedic rasayana drug, protects mice against radiation-induced lethality by free-radical scavenging. *J Altern Complement Med* 2004;10:971-8.
76. Jagetia GC, Venkatesha VA, Reddy TK. Naringin, a citrus flavonone, protects against radiation-induced chromosome damage in mouse bone marrow. *Mutagenesis* 2003;18:337-43.
77. Jurkiewicz BA, Bissett DL, Buettner GR. Effect of topically applied tocopherol on ultraviolet radiation-mediated free radical damage in skin. *J Invest Dermatol* 1995;104:484-8.
78. Kalns J, Ryan KL, Mason PA, Bruno JG, Gooden R, Kiel JL. Oxidative stress precedes circulatory failure induced by 35-GHz microwave heating. *Shock* 2000;13:52-9.
79. Karslioglu I, Ertekin MV, Taysi S, et al. Radioprotective effects of melatonin on radiation-induced cataract. *J Radiat Res (Tokyo)* 2005;46:277-82.
80. Kim KC, Piao MJ, Cho SJ, Lee NH, Hyun JW. Phloroglucinol protects human keratinocytes from ultraviolet B radiation by attenuating oxidative stress. *Photodermatol Photoimmunol Photomed* 2012;28:322-31.
81. Klebanoff SJ. The effect of x-radiation on the glutathione metabolism of intact erythrocytes in vitro. *J Gen Physiol* 1958;41:725-36.
82. Koc M, Taysi S, Emin Buyukokuroglu M, Bakan N. The effect of melatonin against oxidative damage during total-body irradiation in rats. *Radiat Res* 2003;160:251-5.
83. Koiram PR, Veerapur VP, Kunwar A, et al. Effect of curcumin and curcumin copper complex (1:1) on radiation-induced changes of anti-oxidant enzymes levels in the livers of Swiss albino mice. *J Radiat Res* 2007;48:241-5.
84. Kowalski S. Changes of antioxidant activity and formation of 5-hydroxymethylfurfural in honey during thermal and microwave processing. *Food Chem* 2013;141:1378-82.
85. Koylu H, Mollaoglu H, Ozguner F, Naziroglu M, Delibas N. Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain. *Toxicol Ind Health* 2006;22:211-6.
86. Koyu A, Ozguner F, Yilmaz H, Uz E, Cesur G, Ozcelik N. The protective effect of caffeic acid phenethyl ester (CAPE) on oxidative stress in rat liver exposed to the 900 MHz electromagnetic field. *Toxicol Ind Health* 2009;25:429-34.
87. Lai H, Singh NP. Melatonin and a spin-trap compound block radiofrequency electromagnetic radiation-induced DNA strand breaks in rat brain cells. *Bioelectromagnetics* 1997;18:446-54.
88. Lai H, Singh NP. Melatonin and N-tert-butyl-alpha-phenylnitron block 60-Hz magnetic field-induced DNA single and double strand breaks in rat brain cells. *J Pineal Res* 1997;22:152-62.



89. Lai H, Singh NP. Magnetic-field-induced DNA strand breaks in brain cells of the rat. *Environ Health Perspect* 2004;112:687-94.
90. Lantow M, Schuderer J, Hartwig C, Simko M. Free radical release and HSP70 expression in two human immune-relevant cell lines after exposure to 1800 MHz radiofrequency radiation. *Radiat Res* 2006;165:88-94.
91. Lee BC, Johng HM, Lim JK, et al. Effects of extremely low frequency magnetic field on the antioxidant defense system in mouse brain: a chemiluminescence study. *J Photochem Photobiol B* 2004;73:43-8.
92. Lee JH, Park JW. The effect of alpha-phenyl-N-t-butyl nitron on ionizing radiation-induced apoptosis in U937 cells. *Free Radic Res* 2005;39:1325-33.
93. Li HT, Schuler C, Leggett RE, Levin RM. Differential effects of coenzyme Q10 and alpha-lipoic acid on two models of in vitro oxidative damage to the rabbit urinary bladder. *Int Urol Nephrol* 2011;43:91-7.
94. Li P, Zhao QL, Wu LH, et al. Isofraxidin, a potent reactive oxygen species (ROS) scavenger, protects human leukemia cells from radiation-induced apoptosis via ROS/mitochondria pathway in p53-independent manner. *Apoptosis* 2014;19:1043-53.
95. Lin SY, Chang HP. Induction of superoxide dismutase and catalase activity in different rat tissues and protection from UVB irradiation after topical application of Ginkgo biloba extracts. *Methods Find Exp Clin Pharmacol* 1997;19:367-71.
96. Lourencini da Silva R, Albano F, Lopes dos Santos LR, Tavares AD, Jr., Felzenszwalb I. The effect of electromagnetic field exposure on the formation of DNA lesions. *Redox Rep* 2000;5:299-301.
97. Low WK, Sun L, Tan MG, Chua AW, Wang DY. L-N-Acetylcysteine protects against radiation-induced apoptosis in a cochlear cell line. *Acta Otolaryngol* 2008;128:440-5.
98. Lulli M, Witort E, Papucci L, et al. Coenzyme Q10 protects retinal cells from apoptosis induced by radiation in vitro and in vivo. *J Radiat Res* 2012;53:695-703.
99. Maaroufi K, Save E, Poucet B, Sakly M, Abdelmelek H, Had-Aissouni L. Oxidative stress and prevention of the adaptive response to chronic iron overload in the brain of young adult rats exposed to a 150 kilohertz electromagnetic field. *Neuroscience* 2011;186:39-47.
100. Mailankot M, Kunnath AP, Jayalekshmi H, Koduru B, Valsalan R. Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats. *Clinics (Sao Paulo)* 2009;64:561-5.
101. Manda K, Anzai K, Kumari S, Bhatia AL. Melatonin attenuates radiation-induced learning deficit and brain oxidative stress in mice. *Acta Neurobiol Exp (Wars)* 2007;67:63-70.
102. Manda K, Bhatia AL. Pre-administration of beta-carotene protects tissue glutathione and lipid peroxidation status following exposure to gamma radiation. *J Environ Biol* 2003;24:369-72.
103. Manda K, Reiter RJ. Melatonin maintains adult hippocampal neurogenesis and cognitive functions after irradiation. *Prog Neurobiol* 2010;90:60-8.
104. Martinez-Samano J, Torres-Duran PV, Juarez-Oropeza MA, Elias-Vinas D, Verdugo-Diaz L. Effects of acute electromagnetic field exposure and movement restraint on antioxidant system in liver, heart, kidney and plasma of Wistar rats: a preliminary report. *Int J Radiat Biol* 2010;86:1088-94.
105. Mathew ST, Bergstrom P, Hammarsten O. Repeated Nrf2 stimulation using sulforaphane protects fibroblasts from ionizing radiation. *Toxicol Appl Pharmacol* 2014;276:188-94.



106. McArdle AH. Protection from radiation injury by elemental diet: does added glutamine change the effect? *Gut* 1994;35:S60-4.
107. Meena R, Kumari K, Kumar J, Rajamani P, Verma HN, Kesari KK. Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats. *Electromagn Biol Med* 2014;33:81-91.
108. Megha K, Deshmukh PS, Banerjee BD, Tripathi AK, Abegaonkar MP. Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats. *Indian J Exp Biol* 2012;50:889-96.
109. Mishra S, Reddy DS, Jamwal VS, et al. Semiquinone derivative isolated from *Bacillus* sp. INM-1 protects cellular antioxidant enzymes from gamma-radiation-induced renal toxicity. *Mol Cell Biochem* 2013;379:19-27.
110. Mitchell JB, Russo A. The role of glutathione in radiation and drug induced cytotoxicity. *Br J Cancer Suppl* 1987;8:96-104.
111. Molla M, Gironella M, Salas A, et al. Protective effect of superoxide dismutase in radiation-induced intestinal inflammation. *Int J Radiat Oncol Biol Phys* 2005;61:1159-66.
112. Morabito C, Rovetta F, Bizzarri M, Mazzoleni G, Fano G, Mariggio MA. Modulation of redox status and calcium handling by extremely low frequency electromagnetic fields in C2C12 muscle cells: A real-time, single-cell approach. *Free Radic Biol Med* 2010;48:579-89.
113. Moustafa YM, Moustafa RM, Belacy A, Abou-El-Ela SH, Ali FM. Effects of acute exposure to the radiofrequency fields of cellular phones on plasma lipid peroxide and antioxidant activities in human erythrocytes. *J Pharm Biomed Anal* 2001;26:605-8.
114. Musaev AV, Ismailova LF, Shabanova AB, Magerramov AA, Iusifov E, Gadzhiev AM. [Pro- and antioxidant effect of electromagnetic fields of extremely high frequency (460 MHz) on brain tissues in experiment]. *Vopr Kurortol Fizioter Lech Fiz Kult* 2004:19-23.
115. Mukundan H, Bahadur AK, Kumar A, et al. Glutathione level and its relation to radiation therapy in patients with cancer of uterine cervix. *Indian J Exp Biol* 1999;37:859-64.
116. Navarro J, Obrador E, Pellicer JA, Aseni M, Vina J, Estrela JM. Blood glutathione as an index of radiation-induced oxidative stress in mice and humans. *Free Radic Biol Med* 1997;22:1203-9.
117. Okano H. Effects of static magnetic fields in biology: role of free radicals. *Front Biosci* 2008;13:6106-25.
118. Oktem F, Ozguner F, Mollaoglu H, Koyu A, Uz E. Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin. *Arch Med Res* 2005;36:350-5.
119. Oral B, Guney M, Ozguner F, et al. Endometrial apoptosis induced by a 900-MHz mobile phone: preventive effects of vitamins E and C. *Adv Ther* 2006;23:957-73.
120. Ozguner F, Altinbas A, Ozaydin M, et al. Mobile phone-induced myocardial oxidative stress: protection by a novel antioxidant agent caffeic acid phenethyl ester. *Toxicol Ind Health* 2005;21:223-30.
121. Ozguner F, Bardak Y, Comlekci S. Protective effects of melatonin and caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone: a comparative study. *Mol Cell Biochem* 2006;282:83-8.
122. Ozguner F, Oktem F, Armagan A, et al. Comparative analysis of the protective effects of melatonin and caffeic acid phenethyl ester (CAPE) on mobile phone-induced renal impairment in rat. *Mol Cell Biochem* 2005;276:31-7.



123. Ozguner F, Oktem F, Ayata A, Koyu A, Yilmaz HR. A novel antioxidant agent caffeic acid phenethyl ester prevents long-term mobile phone exposure-induced renal impairment in rat. Prognostic value of malondialdehyde, N-acetyl-beta-D-glucosaminidase and nitric oxide determination. *Mol Cell Biochem* 2005;277:73-80.
124. Ozyurt H, Cevik O, Ozgen Z, et al. Quercetin protects radiation-induced DNA damage and apoptosis in kidney and bladder tissues of rats. *Free Radic Res* 2014;48:1247-55.
125. Pall ML. Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev Environ Health* 2015;30:99-116.
126. Patruno A, Tabrez S, Pesce M, Shakil S, Kamal MA, Reale M. Effects of extremely low frequency electromagnetic field (ELF-EMF) on catalase, cytochrome P450 and nitric oxide synthase in erythro-leukemic cells. *Life Sci* 2015;121:117-23.
127. Patwardhan RS, Sharma D, Checker R, Thoh M, Sandur SK. Spatio-temporal changes in glutathione and thioredoxin redox couples during ionizing radiation-induced oxidative stress regulate tumor radio-resistance. *Free Radic Res* 2015;49:1218-32.
128. Paul P, Bansal P, Nayak PG, Pannakal ST, Priyadarsini KI, Unnikrishnan MK. Polyphenolic fraction of *Pilea microphylla* (L.) protects Chinese hamster lung fibroblasts against gamma-radiation-induced cytotoxicity and genotoxicity. *Environ Toxicol Pharmacol* 2012;33:107-19.
129. Pei H, Chen W, Hu W, et al. GANRA-5 protects both cultured cells and mice from various radiation types by functioning as a free radical scavenger. *Free Radic Res* 2014;48:670-8.
130. Piao MJ, Hyun YJ, Oh TH, et al. *Chondracanthus tenellus* (Harvey) hommersand extract protects the human keratinocyte cell line by blocking free radicals and UVB radiation-induced cell damage. *In Vitro Cell Dev Biol Anim* 2012;48:666-74.
131. Pillai S, Oresajo C, Hayward J. Ultraviolet radiation and skin aging: roles of reactive oxygen species, inflammation and protease activation, and strategies for prevention of inflammation-induced matrix degradation - a review. *Int J Cosmet Sci* 2005;27:17-34.
132. Rabbani ZN, Salahuddin FK, Yarmolenko P, et al. Low molecular weight catalytic metalloporphyrin antioxidant AEOL 10150 protects lungs from fractionated radiation. *Free Radic Res* 2007;41:1273-82.
133. Regoli F, Gorbi S, Machella N, et al. Pro-oxidant effects of extremely low frequency electromagnetic fields in the land snail *Helix aspersa*. *Free Radic Biol Med* 2005;39:1620-8.
134. Reliene R, Pollard JM, Sobol Z, Trouiller B, Gatti RA, Schiestl RH. N-acetyl cysteine protects against ionizing radiation-induced DNA damage but not against cell killing in yeast and mammals. *Mutat Res* 2009;665:37-43.
135. Roginskaya M, Bernhard WA, Razskazovskiy Y. Protection of DNA against direct radiation damage by complex formation with positively charged polypeptides. *Radiat Res* 2006;166:9-18.
136. Saenko Y, Cieslar-Pobuda A, Skonieczna M, Rzeszowska-Wolny J. Changes of reactive oxygen and nitrogen species and mitochondrial functioning in human K562 and HL60 cells exposed to ionizing radiation. *Radiat Res* 2013;180:360-6.
137. Sainz RM, Reiter RJ, Tan DX, et al. Critical role of glutathione in melatonin enhancement of tumor necrosis factor and ionizing radiation-induced apoptosis in prostate cancer cells in vitro. *J Pineal Res* 2008;45:258-70.



138. Sener G, Jahovic N, Tosun O, Atasoy BM, Yegen BC. Melatonin ameliorates ionizing radiation-induced oxidative organ damage in rats. *Life Sci* 2003;74:563-72.
139. Sener G, Kabasakal L, Atasoy BM, et al. Ginkgo biloba extract protects against ionizing radiation-induced oxidative organ damage in rats. *Pharmacol Res* 2006;53:241-52.
140. Seyhan N, Guler G. Review of in vivo static and ELF electric fields studies performed at Gazi Biophysics Department. *Electromagn Biol Med* 2006;25:307-23.
141. Shafiee H, Mohammadi H, Rezayat SM, et al. Prevention of malathion-induced depletion of cardiac cells mitochondrial energy and free radical damage by a magnetic magnesium-carrying nanoparticle. *Toxicol Mech Methods* 2010;20:538-43.
142. Sharma R, Tiku AB. Emodin, an anthraquinone derivative, protects against gamma radiation-induced toxicity by inhibiting DNA damage and oxidative stress. *Int J Radiat Biol* 2014;90:275-83.
143. Shi S, Wang G, Wang Y, Zhang L, Zhang L. Protective effect of nitric oxide against oxidative stress under ultraviolet-B radiation. *Nitric Oxide* 2005;13:1-9.
144. Shirazi A, Mihandoost E, Mohseni M, Ghazi-Khansari M, Rabie Mahdavi S. Radio-protective effects of melatonin against irradiation-induced oxidative damage in rat peripheral blood. *Phys Med* 2013;29:65-74.
145. Simko M. Cell type specific redox status is responsible for diverse electromagnetic field effects. *Curr Med Chem* 2007;14:1141-52.
146. Simko M, Droste S, Kriehuber R, Weiss DG. Stimulation of phagocytosis and free radical production in murine macrophages by 50 Hz electromagnetic fields. *Eur J Cell Biol* 2001;80:562-6.
147. Sirerol JA, Feddi F, Mena S, et al. Topical treatment with pterostilbene, a natural phytoalexin, effectively protects hairless mice against UVB radiation-induced skin damage and carcinogenesis. *Free Radic Biol Med* 2015;85:1-11.
148. Smith-Pearson PS, Kooshki M, Spitz DR, Poole LB, Zhao W, Robbins ME. Decreasing peroxiredoxin II expression decreases glutathione, alters cell cycle distribution, and sensitizes glioma cells to ionizing radiation and H₂O₂. *Free Radic Biol Med* 2008;45:1178-89.
149. Song L, Wang D, Cui X, Hu W. The protective action of taurine and L-arginine in radiation pulmonary fibrosis. *J Environ Pathol Toxicol Oncol* 1998;17:151-7.
150. Stevens RG. Electromagnetic fields and free radicals. *Environ Health Perspect* 2004;112:A726; author reply A.
151. Taysi S, Koc M, Buyukokuroglu ME, Altinkaynak K, Sahin YN. Melatonin reduces lipid peroxidation and nitric oxide during irradiation-induced oxidative injury in the rat liver. *J Pineal Res* 2003;34:173-7.
152. Thotala D, Chetyrkin S, Hudson B, Hallahan D, Voziyan P, Yazlovitskaya E. Pyridoxamine protects intestinal epithelium from ionizing radiation-induced apoptosis. *Free Radic Biol Med* 2009;47:779-85.
153. Tofani S, Barone D, Berardelli M, et al. Static and ELF magnetic fields enhance the in vivo anti-tumor efficacy of cis-platin against lewis lung carcinoma, but not of cyclophosphamide against B16 melanotic melanoma. *Pharmacol Res* 2003;48:83-90.
154. Tulard A, Hoffschir F, de Boisferon FH, Luccioni C, Bravard A. Persistent oxidative stress after ionizing radiation is involved in inherited radiosensitivity. *Free Radic Biol Med* 2003;35:68-77.



155. Tunez I, Drucker-Colin R, Jimena I, et al. Transcranial magnetic stimulation attenuates cell loss and oxidative damage in the striatum induced in the 3-nitropropionic model of Huntington's disease. *J Neurochem* 2006;97:619-30.
156. von Deutsch AW, Mitchell CD, Williams CE, et al. Polyamines protect against radiation-induced oxidative stress. *Gravit Space Biol Bull* 2005;18:109-10.
157. Vujaskovic Z, Batinic-Haberle I, Rabbani ZN, et al. A small molecular weight catalytic metalloporphyrin antioxidant with superoxide dismutase (SOD) mimetic properties protects lungs from radiation-induced injury. *Free Radic Biol Med* 2002;33:857-63.
158. Wolf FI, Torsello A, Tedesco B, et al. 50-Hz extremely low frequency electromagnetic fields enhance cell proliferation and DNA damage: possible involvement of a redox mechanism. *Biochim Biophys Acta* 2005;1743:120-9.
159. Xu Y, Parmar K, Du F, Price BD, Sun Y. The radioprotective agent WR1065 protects cells from radiation damage by regulating the activity of the Tip60 acetyltransferase. *Int J Biochem Mol Biol* 2011;2:295-302.
160. Yakymenko I, Tsybulin O, Sidorik E, Henshel D, Kyrylenko O, Kyrylenko S. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. *Electromagn Biol Med* 2015;35:186-202.
161. Yang Y, Li B, Liu C, et al. Hydrogen-rich saline protects immunocytes from radiation-induced apoptosis. *Med Sci Monit* 2012;18:BR144-8.
162. Yokoyama H, Sato T, Ogata T, Ohya-Nishiguchi H, Kamada H. In vivo longitudinally detected ESR measurements at microwave regions of 300, 700, and 900 MHz in rats treated with a nitroxide radical. *J Magn Reson* 1997;129:201-6.
163. Yokus B, Cakir DU, Akdag MZ, Sert C, Mete N. Oxidative DNA damage in rats exposed to extremely low frequency electro magnetic fields. *Free Radic Res* 2005;39:317-23.
164. Yoshida T, Goto S, Kawakatsu M, Urata Y, Li TS. Mitochondrial dysfunction, a probable cause of persistent oxidative stress after exposure to ionizing radiation. *Free Radic Res* 2012;46:147-53.
165. Yoshikawa T, Tanigawa M, Tanigawa T, Imai A, Hongo H, Kondo M. Enhancement of nitric oxide generation by low frequency electromagnetic field. *Pathophysiology* 2000;7:131-5.
166. Zhang R, Kang KA, Piao MJ, et al. Eckol protects V79-4 lung fibroblast cells against gamma-ray radiation-induced apoptosis via the scavenging of reactive oxygen species and inhibiting of the c-Jun NH(2)-terminal kinase pathway. *Eur J Pharmacol* 2008;591:114-23.
167. Zhou BR, Yin HB, Xu Y, et al. Baicalin protects human skin fibroblasts from ultraviolet A radiation-induced oxidative damage and apoptosis. *Free Radic Res* 2012;46:1458-71.
168. Zhu W, Xu J, Ge Y, et al. Epigallocatechin-3-gallate (EGCG) protects skin cells from ionizing radiation via heme oxygenase-1 (HO-1) overexpression. *J Radiat Res* 2014;55:1056-65.
169. Zmyslony M, Palus J, Dziubaltowska E, et al. Effects of in vitro exposure to power frequency magnetic fields on UV-induced DNA damage of rat lymphocytes. *Bioelectromagnetics* 2004;25:560-2.
170. Zmyslony M, Politanski P, Rajkowska E, Szymczak W, Jajte J. Acute exposure to 930 MHz CW electromagnetic radiation in vitro affects reactive oxygen species level in rat lymphocytes treated by iron ions. *Bioelectromagnetics* 2004;25:324-8.
171. Zmyslony M, Rajkowska E, Mamrot P, Politanski P, Jajte J. The effect of weak 50 Hz magnetic fields on the number of free oxygen radicals in rat lymphocytes in vitro. *Bioelectromagnetics* 2004;25:607-12.



172. Petty RK, Harding AE, Morgan-Hughes JA. The clinical features of mitochondrial myopathy. *Brain* 1986;109 (Pt 5):915-38.
173. Frantseva MV, Velazquez JL, Hwang PA, Carlen PL. Free radical production correlates with cell death in an in vitro model of epilepsy. *Eur J Neurosci* 2000;12:1431-9.
174. DiMauro S, Andreu AL, De Vivo DC. Mitochondrial disorders. *J Child Neurol* 2002;17 Suppl 3:3S35-45; discussion 3S6-7.
175. Marin-Garcia J, Goldenthal MJ, Filiano JJ. Cardiomyopathy associated with neurologic disorders and mitochondrial phenotype. *J Child Neurol* 2002;17:759-65.
176. Kouchaki E, Motaghedifard M, Banafshe HR. Effect of mobile phone radiation on pentylenetetrazole-induced seizure threshold in mice. *Iran J Basic Med Sci* 2016;19:800-3.
177. Madmani ME, Yusuf Solaiman A, Tamr Agha K, et al. Coenzyme Q10 for heart failure. *Cochrane Database Syst Rev* 2014;6:CD008684.
178. Taub PR, Ramirez-Sanchez I, Ciaraldi TP, et al. Alterations in skeletal muscle indicators of mitochondrial structure and biogenesis in patients with type 2 diabetes and heart failure: effects of epicatechin rich cocoa. *Clin Transl Sci* 2012;5:43-7.
179. Indik JH, Goldman S, Gaballa MA. Oxidative stress contributes to vascular endothelial dysfunction in heart failure. *Am J Physiol Heart Circ Physiol* 2001;281:H1767-70.
180. Sharma R, Davidoff MN. Oxidative stress and endothelial dysfunction in heart failure. *Congest Heart Fail* 2002;8:165-72.
181. Wolfram R, Oguogho A, Palumbo B, Sinzinger H. Enhanced oxidative stress in coronary heart disease and chronic heart failure as indicated by an increased 8-epi-PGF(2alpha). *Eur J Heart Fail* 2005;7:167-72.
182. White M, Ducharme A, Ibrahim R, et al. Increased systemic inflammation and oxidative stress in patients with worsening congestive heart failure: improvement after short-term inotropic support. *Clin Sci (Lond)* 2006.
183. Kang D, Hamasaki N. Alterations of mitochondrial DNA in common diseases and disease states: aging, neurodegeneration, heart failure, diabetes, and cancer. *Curr Med Chem* 2005;12:429-41.
184. Kerimoglu G, Mercantepe T, Erol, H.S.
- Turgut, A, Kaya H, Colakoglu S, Odaci E. Effects of long term exposure to 900 megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats. *Biotech Histochem* 2016;Aug 11: 1-10 {Epub ahead of print}.
185. Finsterer J. Cognitive decline as a manifestation of mitochondrial disorders (mitochondrial dementia). *J Neurol Sci* 2008;272:20-33.
186. Reiter RJ, Tan DX, Pappolla MA. Melatonin relieves the neural oxidative burden that contributes to dementias. *Ann N Y Acad Sci* 2004;1035:179-96.
187. Popescu BO, Toescu EC, Popescu LM, et al. Blood-brain barrier alterations in ageing and dementia. *J Neurol Sci* 2009;283:99-106.
188. Pappolla MA, Chyan YJ, Poeggeler B, et al. Alzheimer beta protein mediated oxidative damage of mitochondrial DNA: prevention by melatonin. *J Pineal Res* 1999;27:226-9.
189. Matsubara E, Bryant-Thomas T, Pacheco Quinto J, et al. Melatonin increases survival and inhibits oxidative and amyloid pathology in a transgenic model of Alzheimer's disease. *J Neurochem* 2003;85:1101-8.



190. Feng Z, Qin C, Chang Y, Zhang JT. Early melatonin supplementation alleviates oxidative stress in a transgenic mouse model of Alzheimer's disease. *Free Radic Biol Med* 2006;40:101-9.
191. Nittby H, Grafstrom G, Tian DP, et al. Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation. *Bioelectromagnetics* 2007.
192. Kim JY, Kim HJ, Kwon KN, Park MJ. Effects of radiofrequency field exposure on glutamate-induced oxidative stress in mouse hippocampal HT22 cells. *Int J Radiat Biol* 2016;Sept 20:1-22 {Epub ahead of print}.
193. Mugunthan N, Shanmugasamy K, Anbalagan J, Rajanarayanan S, Meenachi S. Effects of long term exposure of 9001800 MHz radiation emitted from 2G mobile phone on mice hippocampus - A histomorphometric study. *J Clin Diagn Res* 2016;10:AF01-6.
194. Killin LOJ, Starr JM, Shiue IJ, Russ TC. Environmental risk factors for dementia: a systematic review. *BMC Geriatrics* 2016;12 Oct:DOI: 10.1186/s12877-016-0342-y.
195. Sonmez OF, Odaci E, Bas O, Kaplan S. Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field. *Brain Res* 2010;1356:95-101.
196. Herbert MR, Sage C. Autism and EMF? Plausibility of a pathophysiological link – Part I. *Pathophysiology* 2013;20:191-209.
197. Zueva NA, Kovalenko AN, Gerasimenko TI, Man'kovskii BN, Korpachova TI, Efimov AS. [Analysis of irradiation dose, body mass index and insulin blood concentration in personnel cleaning up after the Chernobyl nuclear plant accident]. *Lik Sprava* 2001:26-8.
198. Grigor'ev Iu G, Grigor'ev OA, Ivanov AA, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 1. Mobile communications and changes in electromagnetic conditions for the population. Needs for additional substantiation of the existing hygienic standards]. *Radiats Biol Radioecol* 2010;50:6-11.
199. Grigor'ev Iu G, Grigor'ev OA, Merkulov AV, Shafirkin AV, Vorob'ev AA. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 2. General scheme and conditions of the experiment. Development of RF exposure conditions complying with experimental tasks. Animal's status during the long-term exposure]. *Radiats Biol Radioecol* 2010;50:12-6.
200. Grigor'ev Iu G, Shafirkin AV, Nosocskii AM. [New data for proving the presence of significant effects of electromagnetic exposure (to autoimmune changes in rats)]. *Radiats Biol Radioecol* 2011;51:721-30.
201. Brainard GC, Kavet R, Kheifets LI. The relationship between electromagnetic field and light exposures to melatonin and breast cancer risk: a review of the relevant literature. *J Pineal Res* 1999;26:65-100.
202. Milham S. A cluster of male breast cancer in office workers. *Am J Ind Med* 2004;46:86-7.
203. Milham S, Ossiander E. Electric typewriter exposure and increased female breast cancer mortality in typists. *Med Hypotheses* 2007;68:450-1.
204. Naziroglu M, Tokat S, Demirci S. Role of melatonin on electromagnetic radiation-induced oxidative stress and Ca²⁺ signaling molecular pathways in breast cancer. *J Recept Signal Transduct Res* 2012;32:290-7.
205. Zhao G, Lin X, Zhou M, Zhao J. Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis. *Eur J Gynaecol Oncol* 2014;35:264-9.
206. Coureau G, Bouvier G, Lebailly P, et al. Mobile phone use and brain tumours in the CERENAT case-control study. *Occup Environ Med*;71:514-22.



207. Carlberg M, Hardell L. Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones. *Int J Environ Res Public Health* 2014;11:10790-805.
208. Carlberg M, Hardell L. Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation. *Biomed Res Int* 2017;2017:9218486.
209. Carlberg M, Koppel T, Ahonen M, Hardell L. Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk. *Am J Ind Med* 2017;April 10 (epub ahead of print).
210. Carlberg M, Hardell L. Evaluation of mobile phone and cordless phone use and glioma risk using the Bradford Hill viewpoints from 1965 on. Association or causation? *Biomed Res Int* 2017;Epub Mar 16:<https://www.hindawi.com/journals/bmri/2017/9218486/>
211. Hardell L, Carlberg M, Hansson Mild K. Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. *Pathophysiology* 2013;20:85-110.
212. Hardell L, Carlberg M, Soderqvist F, Mild KH. Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. *Int J Oncol* 2013;43:1036-44.
213. Hardell L, Carlberg M. Use of mobile and cordless phones and survival of patients with glioma. *Neuroepidemiology* 2013;40:101-8.
214. Hardell L, Carlberg M. Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. *Rev Environ Health* 2013;28:97-106.
215. Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* 2011;38:1465-74.
216. Hardell L, Carlberg M, Soderqvist F, Mild KH. Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. *Int J Oncol* 2013;43:1833-45.
217. Hardell L, Carlberg M. 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* 2015;22:1-13.
218. Lerchl A, Kruger H, Niehaus M, Streckert JR, Bitz AK, Hansen V. Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (*Phodopus sungorus*). *J Pineal Res* 2008;44:267-72.
219. Lerchl A, Klose M, Grote K, et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochem Biophys Res Commun* 2015;459:585-90.
220. Adams JA, Galloway TS, Mondal D, Esteves SC, Mathews F. Effect of mobile telephones on sperm quality: a systematic review and meta-analysis. *Environ Int* 2014;70:106-12.
221. Houston BJ, Nixon B, King BV, De Luliis GN, Aitken RJ. The effects of radiofrequency electromagnetic radiation on sperm function. *Reproduction* 2016;152:R263-R76.
222. Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *J Pediatr Urol*;9:223-9.



223. Abeleva EA. [Changes of the Nature of Radiation-Induced Mutation in Spermatids of *Drosophila* under the Influence of Arginine]. *Radiobiologia* 1964;4:426-31.
224. Hong R, Zhang Y, Liu Y, Weng EQ. [Effects of extremely low frequency electromagnetic fields on DNA of testicular cells and sperm chromatin structure in mice]. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi* 2005;23:414-7.
225. Ugras MY, Kurus M, Ates B, Soylemez H, Otlu A, Yilmaz I. *Prunus armeniaca* L (apricot) protects rat testes from detrimental effects of low-dose x-rays. *Nutr Res* 2010;30:200-8.
226. Den Boer PJ, van Loon AA, Mackenbach P, van der Schans GP, Grootegoed JA. Effect of glutathione depletion on the cytotoxicity of xenobiotics and induction of single-strand DNA breaks by ionizing radiation in isolated hamster round spermatids. *Journal of reproduction and fertility* 1990;88:259-69.
227. Liu C, Duan W, Xu S, et al. Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line. *Toxicol Lett* 2013;218:2-9.
228. Yan JG, Agresti M, Bruce T, Yan YH, Granlund A, Matloub HS. Effects of cellular phone emissions on sperm motility in rats. *Fertil Steril* 2007;88:957-64.
229. Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline. *Int J Androl* 2005;28:171-9.
230. Guler G, Tomruk A, Ozgur E, Seyhan N. The effect of radiofrequency radiation on DNA and lipid damage in non-pregnant and pregnant rabbits and their newborns. *Gen Physiol Biophys* 2010;29:59-66.
231. Borhani N, Rajaei F, Salehi Z, Javadi A. Analysis of DNA fragmentation in mouse embryos exposed to an extremely low-frequency electromagnetic field. *Electromagn Biol Med* 2011;30:246-52.
232. Sedeghi T, Ahmadi A, Javadian M, et al. Preterm birth among women living within 600 meters of high voltage overhead power lines: a case-control study. *Rom J Intern Med* 2017;Apr 18:{Epub ahead of print}.
233. Bahreymi Toossi MH, Sadeghnia HR, Mohammad Mahdizadeh Feyzabadi M, et al. Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth. *J Matern Fetal Neonatal Med* 2017;Apr 23 {Epub ahead of print}:1-6.
234. Sudan M, Kheifets L, Arah O, Olsen J, Zeltzer L. Prenatal and Postnatal Cell Phone Exposures and Headaches in Children. *Open Pediatr Med Journal* 2012;6:46-52.
235. Aldad TS, Gan G, Gao XB, Taylor HS. Fetal radiofrequency radiation exposure from 800-1900 mhz-rated cellular telephones affects neurodevelopment and behavior in mice. *Sci Rep*;2:312.
236. Shahin S, Singh VP, Shukla RK, et al. 2.45 GHz microwave irradiation-induced oxidative stress affects implantation or pregnancy in mice, *Mus musculus*. *Appl Biochem Biotechnol* 2013;169:1727-51.
237. Othman H, Ammari M, Sakly M, Abdelmelek H. Effects of prenatal exposure to WiFi signal on postnatal development and behavior in rat: Influence of maternal restraint. *Behavioral Brain Research* 2017;36:291-302.
238. Zarei S, Mortazavi SMJ, Mehdizadeh AR, et al. A Challenging Issue in the Etiology of Speech Problems: The Effect of Maternal Exposure to Electromagnetic Fields on Speech Problems in the Offspring. *Journal of Biomedical Physics & Engineering* 2015;5:151-4.
239. Divan HA, Kheifets L, Obel C, Olsen J. Prenatal and postnatal exposure to cell phone use and behavioral problems in children. *Epidemiology* 2008;19:523-9.



240. Divan HA, Kheifets L, Obel C, Olsen J. Cell phone use and behavioural problems in young children. *J Epidemiol Community Health* 2012;66:524-9.
241. Birks L, Guxens M, Papadopoulou E, et al. Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts. *Environment International* 2017.
242. Reiter RJ. Alterations of the circadian melatonin rhythm by the electromagnetic spectrum: a study in environmental toxicology. *Regul Toxicol Pharmacol* 1992;15:226-44.
243. Reiter RJ. Static and extremely low frequency electromagnetic field exposure: reported effects on the circadian production of melatonin. *J Cell Biochem* 1993;51:394-403.
244. Reiter RJ. Electromagnetic fields and melatonin production. *Biomed Pharmacother* 1993;47:439-44.
245. Reiter RJ. Melatonin suppression by static and extremely low frequency electromagnetic fields: relationship to the reported increased incidence of cancer. *Rev Environ Health* 1994;10:171-86.
246. Fernie KJ, Bird DM, Petittlerc D. Effects of electromagnetic fields on photophasic circulating melatonin levels in American kestrels. *Environ Health Perspect* 1999;107:901-4.
247. Griefahn B, Kunemund C, Blaszkewicz M, Lerchl A, Degen GH. Effects of electromagnetic radiation (bright light, extremely low-frequency magnetic fields, infrared radiation) on the circadian rhythm of melatonin synthesis, rectal temperature, and heart rate. *Ind Health* 2002;40:320-7.
248. Jarupat S, Kawabata A, Tokura H, Borkiewicz A. Effects of the 1900 MHz electromagnetic field emitted from cellular phone on nocturnal melatonin secretion. *J Physiol Anthropol Appl Human Sci* 2003;22:61-3.
249. [Melatonin in the environmental medicine diagnosis in connection with electromagnetic fields: statement of the commission "Methods and Quality Assurance in Environmental Medicine"]. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz* 2005;48:1406-8.
250. Rapoport SI, Breus TK. [Melatonin as a most important factor of natural electromagnetic fields impacting patients with hypertensive disease and coronary heart disease. Part 1]. *Klin Med (Mosk)* 2011;89:9-14.
251. Dyche J, Anch AM, Fogler KA, Barnett DW, Thomas C. Effects of power frequency electromagnetic fields on melatonin and sleep in the rat. *Emerg Health Threats J* 2012;5.
252. Qin F, Zhang J, Cao H, et al. Effects of 1800-MHz radiofrequency fields on circadian rhythm of plasma melatonin and testosterone in male rats. *J Toxicol Environ Health A* 2012;75:1120-8.
253. Bagchi M, Balmoori J, Ye X, Bagchi D, Ray SD, Stohs SJ. Protective effect of melatonin on naphthalene-induced oxidative stress and DNA damage in cultured macrophage J774A.1 cells. *Mol Cell Biochem* 2001;221:49-55.
254. Abdel Moneim AE, Ortiz F, Leonardo-Mendonca RC, et al. Protective effects of melatonin against oxidative damage induced by Egyptian cobra (*Naja haje*) crude venom in rats. *Acta Trop* 2015;143:58-65.
255. Abd-Elghaffar S, El-Sokkary GH, Sharkawy AA. Aluminum-induced neurotoxicity and oxidative damage in rabbits: protective effect of melatonin. *Neuro Endocrinol Lett* 2005;26:609-16.
256. Abdel-Wahab MH, Arafa HM, El-Mahdy MA, Abdel-Naim AB. Potential protective effect of melatonin against dibromoacetonitrile-induced oxidative stress in mouse stomach. *Pharmacol Res* 2002;46:287-93.
257. Abdel-Wahhab MA, Abdel-Galil MM, El-Lithey M. Melatonin counteracts oxidative stress in rats fed an ochratoxin A contaminated diet. *J Pineal Res* 2005;38:130-5.
258. Abraham P, Kolli VK, Rabi S. Melatonin attenuates methotrexate-induced oxidative stress and renal damage in rats. *Cell Biochem Funct* 2010;28:426-33.



259. Agil A, Reiter RJ, Jimenez-Aranda A, et al. Melatonin ameliorates low-grade inflammation and oxidative stress in young Zucker diabetic fatty rats. *J Pineal Res* 2013;54:381-8.
260. Aksoy N, Vural H, Sabuncu T, Aksoy S. Effects of melatonin on oxidative-antioxidative status of tissues in streptozotocin-induced diabetic rats. *Cell Biochem Funct* 2003;21:121-5.
261. Aktas C, Kanter M, Erboga M, Mete R, Oran M. Melatonin attenuates oxidative stress, liver damage and hepatocyte apoptosis after bile-duct ligation in rats. *Toxicol Ind Health* 2014;30:835-44.
262. Albendea CD, Gomez-Trullen EM, Fuentes-Broto L, et al. Melatonin reduces lipid and protein oxidative damage in synaptosomes due to aluminium. *J Trace Elem Med Biol* 2007;21:261-8.
263. Al-Malki AL. Synergistic effect of lycopene and melatonin against the genesis of oxidative stress induced by cyclophosphamide in rats. *Toxicol Ind Health* 2014;30:570-5.
264. Aranda M, Albendea CD, Lostale F, et al. In vivo hepatic oxidative stress because of carbon tetrachloride toxicity: protection by melatonin and pinoline. *J Pineal Res* 2010;49:78-85.
265. Arushanian EB. [Limitation of oxidative stress as the main factor of the universal protective properties of melatonin]. *Eksp Klin Farmakol* 2012;75:44-9.
266. Bagheri F, Goudarzi I, Lashkarbolouki T, Elahdadi Salmani M. Melatonin prevents oxidative damage induced by maternal ethanol administration and reduces homocysteine in the cerebellum of rat pups. *Behav Brain Res* 2015;287:215-25.
267. Aynali G, Naziroglu M, Celik O, Dogan M, Yariktas M, Yasan H. Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. *Eur Arch Otorhinolaryngol* 2013;270:1695-700.
268. Bardak Y, Ozerturk Y, Ozguner F, Durmus M, Delibas N. Effect of melatonin against oxidative stress in ultraviolet-B exposed rat lens. *Curr Eye Res* 2000;20:225-30.
269. Argun M, Tok L, Uguz AC, Celik O, Tok OY, Naziroglu M. Melatonin and amfenac modulate calcium entry, apoptosis, and oxidative stress in ARPE-19 cell culture exposed to blue light irradiation (405 nm). *Eye (Lond)* 2014;28:752-60.
270. Ayata A, Mollaoglu H, Yilmaz HR, Akturk O, Ozguner F, Altuntas I. Oxidative stress-mediated skin damage in an experimental mobile phone model can be prevented by melatonin. *J Dermatol* 2004;31:878-83.
271. Bhatia AL, Manda K. Study on pre-treatment of melatonin against radiation-induced oxidative stress in mice. *Environ Toxicol Pharmacol* 2004;18:13-20.
272. Guney Y, Hicsonmez A, Uluoglu C, et al. Melatonin prevents inflammation and oxidative stress caused by abdominopelvic and total body irradiation of rat small intestine. *Braz J Med Biol Res* 2007;40:1305-14.
273. Jang SS, Kim HG, Lee JS, et al. Melatonin reduces X-ray radiation-induced lung injury in mice by modulating oxidative stress and cytokine expression. *Int J Radiat Biol* 2013;89:97-105.
274. Kim BC, Shon BS, Ryoo YW, Kim SP, Lee KS. Melatonin reduces X-ray irradiation-induced oxidative damages in cultured human skin fibroblasts. *J Dermatol Sci* 2001;26:194-200.
275. Koc M, Taysi S, Buyukokuroglu ME, Bakan N. Melatonin protects rat liver against irradiation-induced oxidative injury. *J Radiat Res* 2003;44:211-5.
276. Manda K, Ueno M, Anzai K. Melatonin mitigates oxidative damage and apoptosis in mouse cerebellum induced by high-LET 56Fe particle irradiation. *J Pineal Res* 2008;44:189-96.



277. Naziroglu M, Celik O, Ozgul C, et al. Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca(2+) channels in brain and dorsal root ganglion in rat. *Physiol Behav* 2012;105:683-92.
278. Oksay T, Naziroglu M, Dogan S, Guzel A, Gumral N, Kosar PA. Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. *Andrologia* 2012.
279. Sener G, Atasoy BM, Ersoy Y, Arbak S, Sengoz M, Yegen BC. Melatonin protects against ionizing radiation-induced oxidative damage in corpus cavernosum and urinary bladder in rats. *J Pineal Res* 2004;37:241-6.
280. Sharma S, Haldar C. Melatonin prevents X-ray irradiation induced oxidative damage in peripheral blood and spleen of the seasonally breeding rodent, *Funambulus pennanti* during reproductively active phase. *Int J Radiat Biol* 2006;82:411-9.
281. Sokolovic D, Djindjic B, Nikolic J, et al. Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. *J Radiat Res* 2008;49:579-86.
282. Taysi S, Memisogullari R, Koc M, et al. Melatonin reduces oxidative stress in the rat lens due to radiation-induced oxidative injury. *Int J Radiat Biol* 2008;84:803-8.
283. Tok L, Naziroglu M, Dogan S, Kahya MC, Tok O. Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats. *Indian J Ophthalmol* 2014;62:12-5.
284. Yilmaz S, Yilmaz E. Effects of melatonin and vitamin E on oxidative-antioxidative status in rats exposed to irradiation. *Toxicology* 2006;222:1-7.
285. Albers DS, Beal MF. Mitochondrial dysfunction and oxidative stress in aging and neurodegenerative disease. *J Neural Transm Suppl* 2000;59:133-54.
286. Ansari MA, Joshi G, Huang Q, et al. In vivo administration of D609 leads to protection of subsequently isolated gerbil brain mitochondria subjected to in vitro oxidative stress induced by amyloid beta-peptide and other oxidative stressors: relevance to Alzheimer's disease and other oxidative stress-related neurodegenerative disorders. *Free Radic Biol Med* 2006;41:1694-703.
287. Arumugam S, Thandavarayan RA, Arozal W, et al. Quercetin offers cardioprotection against progression of experimental autoimmune myocarditis by suppression of oxidative and endoplasmic reticulum stress via endothelin-1/MAPK signalling. *Free Radic Res* 2012;46:154-63.
288. Barnham KJ, Masters CL, Bush AI. Neurodegenerative diseases and oxidative stress. *Nat Rev Drug Discov* 2004;3:205-14.
289. Bashir S, Harris G, Denman MA, Blake DR, Winyard PG. Oxidative DNA damage and cellular sensitivity to oxidative stress in human autoimmune diseases. *Ann Rheum Dis* 1993;52:659-66.
290. Belch JJ, Mackay IR, Hill A, Jennings P, McCollum P. Oxidative stress is present in atherosclerotic peripheral arterial disease and further increased by diabetes mellitus. *Int Angiol* 1995;14:385-8.
291. Benz CC, Yau C. Ageing, oxidative stress and cancer: paradigms in parallax. *Nat Rev Cancer* 2008;8:875-9.
292. Bernstein AI, Miller GW. Oxidative signaling in experimental autoimmune encephalomyelitis. *Toxicol Sci* 2010;114:159-61.
293. Bonnefont-Rousselot D. Obesity and oxidative stress: potential roles of melatonin as antioxidant and metabolic regulator. *Endocr Metab Immune Disord Drug Targets* 2014;14:159-68.
294. Butterfield DA, Castegna A, Drake J, Scapagnini G, Calabrese V. Vitamin E and neurodegenerative disorders associated with oxidative stress. *Nutr Neurosci* 2002;5:229-39.



295. Butterfield DA, Howard BJ, LaFontaine MA. Brain oxidative stress in animal models of accelerated aging and the age-related neurodegenerative disorders, Alzheimer's disease and Huntington's disease. *Curr Med Chem* 2001;8:815-28.
296. Ceriello A, Motz E. Is oxidative stress the pathogenic mechanism underlying insulin resistance, diabetes, and cardiovascular disease? The common soil hypothesis revisited. *Arterioscler Thromb Vasc Biol* 2004;24:816-23.
297. Chang YC, Chuang LM. The role of oxidative stress in the pathogenesis of type 2 diabetes: from molecular mechanism to clinical implication. *Am J Transl Res* 2010;2:316-31.
298. Chauhan A, Chauhan V. Oxidative stress in autism. *Pathophysiology* 2006;13:171-81.
299. Chauhan A, Chauhan V, Brown WT, Cohen I. Oxidative stress in autism: increased lipid peroxidation and reduced serum levels of ceruloplasmin and transferrin--the antioxidant proteins. *Life Sci* 2004;75:2539-49.
300. Dhaun N, Kluth DC. Oxidative stress promotes hypertension and albuminuria during the autoimmune disease systemic lupus erythematosus. *Hypertension* 2012;59:e47; author reply e8.
301. Dobrian AD, Davies MJ, Schriver SD, Lauterio TJ, Prewitt RL. Oxidative stress in a rat model of obesity-induced hypertension. *Hypertension* 2001;37:554-60.
302. Donkena KV, Young CY, Tindall DJ. Oxidative stress and DNA methylation in prostate cancer. *Obstet Gynecol Int* 2010;2010:302051.
303. Facheris M, Beretta S, Ferrarese C. Peripheral markers of oxidative stress and excitotoxicity in neurodegenerative disorders: tools for diagnosis and therapy? *J Alzheimers Dis* 2004;6:177-84.
304. Gilgun-Sherki Y, Melamed E, Offen D. Oxidative stress induced-neurodegenerative diseases: the need for antioxidants that penetrate the blood brain barrier. *Neuropharmacology* 2001;40:959-75.
305. Henriksen EJ, Diamond-Stanic MK, Marchionne EM. Oxidative stress and the etiology of insulin resistance and type 2 diabetes. *Free Radic Biol Med* 2011;51:993-9.
306. Hoeldtke RD, Bryner KD, VanDyke K. Oxidative stress and autonomic nerve function in early type 1 diabetes. *Clin Auton Res* 2011;21:19-28.
307. Islam MT. Oxidative stress and mitochondrial dysfunction-linked neurodegenerative disorders. *Neurol Res* 2017;39:73-82.
308. James SJ, Cutler P, Melnyk S, et al. Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism. *Am J Clin Nutr* 2004;80:1611-7.
309. Kaffe ET, Rigopoulou EI, Koukoulis GK, Dalekos GN, Moulas AN. Oxidative stress and antioxidant status in patients with autoimmune liver diseases. *Redox Rep* 2015;20:33-41.
310. Karbownik M, Reiter RJ. Melatonin protects against oxidative stress caused by delta-aminolevulinic acid: implications for cancer reduction. *Cancer Invest* 2002;20:276-86.
311. Karbownik M, Reiter RJ, Burkhardt S, Gitto E, Tan DX, Lewinski A. Melatonin attenuates estradiol-induced oxidative damage to DNA: relevance for cancer prevention. *Exp Biol Med (Maywood)* 2001;226:707-12.
312. Kern JK, Jones AM. Evidence of toxicity, oxidative stress, and neuronal insult in autism. *J Toxicol Environ Health B Crit Rev* 2006;9:485-99.
313. Khandrika L, Kumar B, Koul S, Maroni P, Koul HK. Oxidative stress in prostate cancer. *Cancer Lett* 2009.



314. Kovacic P, Jacintho JD. Systemic lupus erythematosus and other autoimmune diseases from endogenous and exogenous agents: unifying theme of oxidative stress. *Mini Rev Med Chem* 2003;3:568-75.
315. Kumagai S, Jikimoto T, Saegusa J. [Pathological roles of oxidative stress in autoimmune diseases]. *Rinsho Byori* 2003;51:126-32.
316. Kumagai S, Nobuhara Y, Saegusa J. [Oxidative stress and autoimmune diseases]. *Nihon Naika Gakkai Zasshi* 2003;92:1096-103.
317. Kupczyk D, Rybka J, Kedziora-Kornatowska K, Kedziora J. [Melatonin and oxidative stress in elderly patients with type 2 diabetes]. *Pol Merkur Lekarski* 2010;28:407-9.
318. Lin MT, Beal MF. Mitochondrial dysfunction and oxidative stress in neurodegenerative diseases. *Nature* 2006;443:787-95.
319. Mariani E, Polidori MC, Cherubini A, Mecocci P. Oxidative stress in brain aging, neurodegenerative and vascular diseases: an overview. *J Chromatogr B Analyt Technol Biomed Life Sci* 2005;827:65-75.
320. McGinnis WR. Oxidative stress in autism. *Altern Ther Health Med* 2005;11:19.
321. Moreno-Otero R. May oxidative stress contribute to autoimmune hepatitis pathogenesis, and can antioxidants be of value as adjuvant therapy for refractory patients? *Dig Dis Sci* 2013;58:1440-1.
322. Nguyen AM, Rao NA. Oxidative photoreceptor cell damage in autoimmune uveitis. *J Ophthalmic Inflamm Infect* 2011;1:7-13.
323. Pandi-Perumal SR, BaHammam AS, Brown GM, et al. Melatonin antioxidative defense: therapeutical implications for aging and neurodegenerative processes. *Neurotox Res* 2013;23:267-300.
324. Pereira EC, Ferderbar S, Bertolami MC, et al. Biomarkers of oxidative stress and endothelial dysfunction in glucose intolerance and diabetes mellitus. *Clin Biochem* 2008;41:1454-60.
325. Pillarisetti S, Saxena U. Role of oxidative stress and inflammation in the origin of Type 2 diabetes--a paradigm shift. *Expert Opin Ther Targets* 2004;8:401-8.
326. Rao AV, Balachandran B. Role of oxidative stress and antioxidants in neurodegenerative diseases. *Nutr Neurosci* 2002;5:291-309.
327. Rodrigues P, de Marco G, Furriol J, et al. Oxidative stress in susceptibility to breast cancer: study in Spanish population. *BMC Cancer* 2014;14:861.
328. Rose S, Melnyk S, Pavliv O, et al. Evidence of oxidative damage and inflammation associated with low glutathione redox status in the autism brain. *Transl Psychiatry* 2012;2:e134.
329. Rossignol DA, Frye RE. A review of research trends in physiological abnormalities in autism spectrum disorders: immune dysregulation, inflammation, oxidative stress, mitochondrial dysfunction and environmental toxicant exposures. *Mol Psychiatry* 2012;17:389-401.
330. Shah AA, Sinha AA. Oxidative stress and autoimmune skin disease. *Eur J Dermatol* 2013;23:5-13.
331. Sheridan J, Wang LM, Tosetto M, et al. Nuclear oxidative damage correlates with poor survival in colorectal cancer. *Br J Cancer* 2009;100:381-8.
332. Sondergaard ES, Gogenur I. [Oxidative stress may cause metastatic disease in patients with colorectal cancer.]. *Ugeskr Laeger* 2014;176.
333. Srinivasan V. Melatonin oxidative stress and neurodegenerative diseases. *Indian J Exp Biol* 2002;40:668-79.



334. Sun GY, Wood WG. Recent developments in understanding oxidative mechanisms and contributions of glial cell activation, mitochondrial dysfunction, and lipids and signaling pathways to neurodegenerative diseases. Preface. *Mol Neurobiol* 2010;41:53-4.
335. Udensi UK, Tchounwou PB. Dual effect of oxidative stress on leukemia cancer induction and treatment. *J Exp Clin Cancer Res* 2014;33:106.
336. Valko M, Rhodes CJ, Moncol J, Izakovic M, Mazur M. Free radicals, metals and antioxidants in oxidative stress-induced cancer. *Chem Biol Interact* 2006;160:1-40.
337. Vessby J, Basu S, Mohsen R, Berne C, Vessby B. Oxidative stress and antioxidant status in type 1 diabetes mellitus. *J Intern Med* 2002;251:69-76.
338. Wells PG, McCallum GP, Chen CS, et al. Oxidative stress in developmental origins of disease: teratogenesis, neurodevelopmental deficits, and cancer. *Toxicol Sci* 2009;108:4-18.
339. Yamamoto T. Autoimmune mechanisms of scleroderma and a role of oxidative stress. *Self Nonsell* 2011;2:4-10.
340. Yao Y, Walsh WJ, McGinnis WR, Pratico D. Altered vascular phenotype in autism: correlation with oxidative stress. *Arch Neurol* 2006;63:1161-4.
341. Yu JH, Kim H. Oxidative stress and cytokines in the pathogenesis of pancreatic cancer. *J Cancer Prev* 2014;19:97-102.
342. Zephy D, Ahmad J. Type 2 diabetes mellitus: Role of melatonin and oxidative stress. *Diabetes Metab Syndr* 2015;9:127-31.
343. Zoroglu SS, Armutcu F, Ozen S, et al. Increased oxidative stress and altered activities of erythrocyte free radical scavenging enzymes in autism. *Eur Arch Psychiatry Clin Neurosci* 2004;254:143-7.
344. Torbenko VP, Bogdanova IA, Gerasimov AM. [Effect of a combined radiation lesion on the enzyme activity of the glutathione redox system of the rat liver]. *Biull Eksp Biol Med* 1983;95:48-50.
345. Erden M, Bor NM. Changes of reduced glutathion, glutathione reductase, and glutathione peroxidase after radiation in guinea pigs. *Biochem Med* 1984;31:217-27.
346. Evans JW, Taylor YC, Brown JM. The role of glutathione and DNA strand break repair in determining the shoulder of the radiation survival curve. *Br J Cancer Suppl* 1984;6:49-53.
347. Boyer TD, Vessey DA, Kempner E. Radiation inactivation of microsomal glutathione S-transferase. *J Biol Chem* 1986;261:16963-8.
348. Connor MJ, Wheeler LA. Depletion of cutaneous glutathione by ultraviolet radiation. *Photochem Photobiol* 1987;46:239-45.
349. Singh LR, Uniyal BP, Mukherjee SK, Sarkar SR, Sharma SK. Effect of whole body gamma-radiation on glutathione reductase of rat tissues. *Strahlenther Onkol* 1987;163:337-9.
350. Leus NF, Kolomiichuk SG, Lishchenko VB. [Activity of glutathione-S-transferase in the blood plasma, liver and crystalline lens tissues as affected by low doses of ionizing radiation and polychromatic light]. *Ukr Biokhim Zh* 1997;69:54-9.
351. Grande S, Luciani AM, Rosi A, et al. Radiation effects on soluble metabolites in cultured HeLa cells examined by ¹H MRS: changes in concentration of glutathione and of lipid catabolites induced by gamma rays and proton beams. *Int J Cancer* 2001;96 Suppl:27-42.
352. Rathgen GH. [Radiation-induced changes of the glutathione content of some rat organs modified by cysteine]. *Strahlentherapie* 1970;139:243-50.



353. Rathgen GH, Lieser H. [Significance of glutathione in radiation effect studies and chemical radiation protection]. *Strahlentherapie* 1972;143:670-6.
354. Sarkar SR, Singh LR, Uniyal BP, Chaudhuri BN. Effect of whole body gamma radiation on reduced glutathione contents of rat tissues. *Strahlentherapie* 1983;159:32-3.
355. Rosi A, Grande S, Luciani AM, et al. Role of glutathione in apoptosis induced by radiation as determined by ¹H MR spectra of cultured tumor cells. *Radiat Res* 2007;167:268-82.
356. Tanita J, Tsuchida S, Hozawa J, Sato K. Expression of glutathione S-transferase-pi in human squamous cell carcinomas of the pharynx and larynx. Loss after radiation therapy. *Cancer* 1993;72:569-76.
357. Vartanyan LS, Gurevich SM, Kozachenko AI, Nagler LG, Lozovskaya EL, Burlakova EB. Changes in superoxide production rate and in superoxide dismutase and glutathione peroxidase activities in subcellular organelles in mouse liver under exposure to low doses of low-intensity radiation. *Biochemistry (Mosc)* 2000;65:442-6.
358. Woodward GE. The effect of ultra-violet, radium and X-ray radiation on glutathione in pure solution. *Biochem J* 1933;27:1411-4.
359. Byun YH, Ha M, Kwon HJ, et al. Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study. *PLoS One* 2013;8:e59742.
360. Sanie-Jahromi F, Saadat Z, Saadat M. Effects of extremely low frequency electromagnetic fields and cisplatin on mRNA levels of some DNA repair genes. *Life Sciences* 2016;3205:30588-4.

Harry Vere Lehmann
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

July 6, 2017

VIA PRIORITY MAIL and/or HAND DELIVERY and/or EMAIL

Assemblymember Marc Levine
5135 State Capitol
Sacramento, CA 95814

Re: Mass casualties are likely in District 10 from passage of SB 649

Dear Assemblymember Levine,

Senate Bill 649, a decision now before you, will likely result in mass fatalities in your District including children, who due to skull development levels and other factors, are more subject than adults to the effects of the carcinogenic cellular radiation which will saturate the homes in your District if this Bill is passed. Like you, I disdain inflammatory phases as such are so often deployed by emotionally over-loaded people with incomplete capture of the facts and science. Yet, directly relevant to SB 649, the Toxicology Program of our federal National Institutes of Health has shown through their \$25 million study, as announced on May 27, 2016, that cellular wireless radiation affects human tissue via non-thermal means and the formation of glioma, the cancer cell which results in glioblastoma (the brain cancer that kills people). Brain cancer killed four of my colleagues and friends which is what led me several years ago into dedication to our work educating consumers about smartphone proximity through www.greenswan.org. SB 649 is not about smart phone proximity but the constant radiation from the 50,000 towers from SB 649 presents a moral necessity to oppose this Bill. SB 649, now pushed by an industry which makes huge donations and contributions, is being advocated to wirelessly supplant cable as a main means of delivering TV, et al. Senate Bill 649 should be stopped in its tracks in order to protect the residents of your District. At the very least, SB 649 should be put on hold pending further study, as our federal Senate decided regarding the federal version of the same Bill, called S-19, pending further study.

As a trial lawyer, I have specialized in engineering and scientific proof civil cases since 1983. As nearly as I can tell I've personally handled approximately 1,600 civil cases, including certified class actions like the Chevron aviation gasoline matter (new engines for 1647 aircraft), the Mobil Oil AV-1 matter (overhauled or replaced engines for 850 aircraft, mostly twins), and I served as part of the plaintiffs' team in the Yuba Flood Cases, which after far too long settled against the State for \$423 million, as well as many hundreds of other cases, some of them also involving large groups of plaintiffs. I am not important, or by contemporary standards wealthy. Like you, I want facts, not hot-headed opinion from

some alarmist. Rather, our opposition to SB 649 is not grounded in emotion, but strongly grounded in science. If this Bill is allowed to be passed by our Assembly and is then signed into law, mass Crimes Against Humanity will likely result due to radiation exposure, **as you are hereby notified and warned**. Dated May 23, 2017, a 14 page submission on this subject was made to the already-overworked Senate Appropriations Committee, which presentation was composed of a detailed and annotated letter over my signature and supported by a Declaration under Penalty of Perjury by Mr. Paul McGavin. Paul and I are mere two of the large of California residents who, like representatives of cities and counties, oppose SB 649. Rather than taking up your time with more of my own words, and having given you this legal Notice of the likely consequences from the passage of SB 649, I respectfully advise you of said letter submitted to Senate Appropriations to your attention, and hereby incorporate that May 23rd Appropriations letter herein by this reference as though more fully set forth. Copies of that letter and Declaration should be immediately available to you from Senator Lara's office if you so request. I note in closing the additional factor that if SB 649 becomes law in California, the State will face ruinous financial loss from the resulting ADA complaints, all as set forth in that incorporated letter. **A selection of sources for your study is listed below**. Thank you.

Very truly yours,



Harry V. Lehmann

A small selection of articles and sources related to non-ionizing radiation and health:

<https://ehtrust.org>

<http://scientists4wiredtech.com>

<http://scientists4wiredtech.com/2017/03/rfr-hazards/>

<https://www.niehs.nih.gov/news/newsletter/2016/6/science-highlights/cellphones/index.htm>

<http://www.motherjones.com/environment/2016/05/federal-study-links-cell-phone-radiation-cancer/>

<http://www.cbc.ca/news/cell-tower-radiation-harmful-to-humans-study-1.958047>

<https://www.wsj.com/articles/cellphone-boom-spurs-antenna-safety-worries-1412293055>

<http://www.latimes.com/business/la-fi-cellphone-5g-health-20160808-snap-story.html>

Harry Vere Lehmann,
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
P. O. Box 1846
Novato, California 94948-1846

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via facsimile of even date and Federal Express.

July 19, 2017

Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee
State Capitol, Room 2114
Sacramento, CA 95814
Via 10 page fax: 916-319-2181
& Federal Express overnight

- Re: 1. Incorrect data given in Telecom testimony regarding Liability: The State faces liability exposure from SB 649
2. Whether exquisitely planned for this inevitable result, or 'just lucky' for Telecom, SB 649 once deployed will have the effect of shifting massive Industry liability to the State of California.

Dear Ms. Galehouse -

The liability-shift component of the SB 649 issue set has not been previously addressed. I didn't see the underlying liability-shift until after the testimony last Wednesday. The liability-shift consequence of SB 649 is a difficult point to see, but essential to be recognized. This letter is divided into two sections, the **GENERAL OVERVIEW** which appears next below presents the gist in three pages, and then a larger section titled **IN GREATER DETAIL**. Because the liability shifting aspect of this analysis was not seen by the undersigned until after the close of testimony on July 12th, and because the Appropriations Committee hearing on SB 649 is only a week away, and because this analysis implies possible billions in losses to the State, an Appropriations issue, this is an initial overview of the situation in the expectation that seasoned and competent unbiased legal analysis will be made of the most startling of the two issues here addressed, before passage of this Bill: In-depth legal analysis is encouraged.

GENERAL OVERVIEW

This letter reaches the conclusions stated through several vectors of analysis but bottom line this boils down to two core points: **1.** During the hearings on SB 649, assurances were given by industry that the telecom companies would be the only entities affected by liability from radiation injuries. That is not true. Rather and instead, through SB 649 California faces potential liability for any injuries claimed to have resulted from the allegedly 'small cell,' antennas delivered to our residents from SB 649. **2.** More profound in implication if true, and difficult to see, **there is a heretofore non-disclosed sequella from SB 649; the potential transfer all financial liability for cellular injury cases from the telecom corporations to the State.**

The State of California faces liability for damages sustained from Senate Bill 649

Typically any very serious or catastrophic injury case will be handled by experienced counsel - I believe any experienced lawyer who has been long engaged in plaintiffs work with governmental entities would agree with the following points, not one involves rocket science:

1) The defendants in a lawsuit do not get to choose whether to be sued. That choice is made by plaintiffs' counsel. There is no way for any industry representative to honestly claim that the State will not be sued for such injuries.

2) Once the involved cellular antenna box is attached to the involved governmental utility pole, for several reasons including the Doctrine of Fixtures as often used in tenancy situations, a melding takes place, and plaintiffs counsel will allege, as is consistent with the law, that the melded unit as a whole is Public Property.

3) Though plaintiffs can't sue the State for negligence or other Common Law causes of action, under our Government Code suit can be brought for Dangerous Condition of Public Property.

4) These *public* utility poles are demonstrably 'Dangerous' within the meaning of Government Code 835, because the radiation they emit has been scientifically proven to be carcinogenic, and the radiation is damaging to the human biological system. This is most dramatically proven by the \$25 million NIH study released on May 27, 2016, showing that cellular radiation causes the malignant cancer cell glioma, which is what causes the deadly brain cancer: glioblastoma.

5) The State of California, as a result of the Firefighters's Exemption, or Firehouse Exemption as it is alternatively called, is, a unique development, ***admitting the dangerous nature of the about-to-be-built 'small cell,' system, because, as a matter of provable Legislative Intent, the firehouses were exempted due to health concerns.*** So our Legislature is poised to create at least 30,000 different pieces of Public Property while in one fell swoop also branding each one as Dangerous. Other examples supportive of this point will appear below, in the discussion of the liability-shifting aspects of SB 649.

Senate Bill 649 can shift liability exposure from the telecom industry to the State of California.

The most important purpose of this letter is to alert Assemblymembers of previously undisclosed economic consequences which to the undersigned appear legally very likely to ensue from the passage of SB 649. State lawyers with extensive trial experience should evaluate what is said here and advise Appropriations and the Assembly whether the warnings here represent real issues. The consequence of greatest concern is that passage of SB 649, contrary to appearances, ***will result in the mass transfer of***

liability for cellular microwave injury from the telecom industry to State government, with \$Billions involved. Whether this here-disclosed consequence is the result of a brilliant and intricate multiple-stage legal stratagem by the best lawyers that Telecom could retain, or whether the industry just got lucky, the result for the State of California will be the same, financial ruin. Consider the following factors:

1. The State can't be sued for 'negligence' or other basic common-law theories of relief, and Claimants can only sue as allowed in the Government Code.
2. The main CA Government Code section which is virtually always pled by all experienced public entity lawyers is Dangerous Condition of Public Property, Government Code 835. .
3. If the 'taking,' of county and city properties in SB 649 is allowed, then what next follows when the cell tower is affixed to the publicly-owned utility pole, due to the 'fixtures,' doctrine and other legal reasons, is the merger of antenna and pole into Public Property. This is a complex issue with other criteria supporting the same Public Property finding.
4. Through the 'Firefighters Exemption' to SB 649, prohibiting cellular antenna construction near where firefighters sleep, based on health grounds as pushed by their unions, ***the State is acknowledging that its new melded-exposure property is Dangerous.***
5. As a result of the above the enabling legislation makes the resulting Public Property Dangerous in character in the light of Government Code 835, which in turn makes lawsuits against the State much easier.
6. There is now overwhelming evidence of DNA and cellular damage from radio-frequency EMF as emitted by cellular phones and towers. If you have doubt about this, set up a debate between me and the best they've got. See prior letters, notably of May 23rd to Senate Appropriations, with integrated sworn Declaration of McGavin.
7. It is a matter of well-established public record that the international re-insurance industry has long refused to insure any aspect of the telecom industry for injuries caused by cellular devices or installations. There is no net.
8. ***The only avenue left to the cellular industry, other than just honestly facing up to this mess and helping us solve it, is to shift the legal responsibility to government.***
9. Though good challenge may be on the horizon, the current stance of federal law under the Telecommunications Reform Act of 1996 it is not possible to prevail against a cellular company for liability for a phone made in roughly the last two decades.

10. Seasoned and competent counsel, where injuries occur of a sort consistent with EMF injury to DNA, including glioblastoma as indicated by glioma from the NIH study, will file suit against responsible corporate entities, broadly, and also sue the State of California. Right now many serious lawyers avoid this area due to the 1996 Telecommunications Reform Act. However the practical immunity offered to telecom under the act is conditional upon compliance with FCC standards, and there are now material means available to show that none of the currently marketed smart phones meet FCC standards when measured *as actually used in the field*, namely up against the face.
11. In the instance of the successful bar to civil prosecution which is currently provided by said industry-inspired 1996 Act, and in a State where 'joint and several liability' means that a 5% liability contributor has 100% of financial responsibility from a loss, ***the result of the combination of the factors stated above is that in the instance of suit, including 'friendly,' all financial burdens from cellular injury are shifted to the State of California, under the results from SB 649 as here-projected, through exercise of the federal regulatory bar to such prosecution of cases against the telecom industry.***

I assert no position as to whether the stream of results capsulized above will arise from the prior formation of an intricate plan from very smart lawyers, or whether the industry just 'got lucky,' in regard to the seemingly inevitable consequences of signing SB 649 into law. It doesn't matter, but when you look five or six moguls down this hill, the financial crash is inevitable. The above introductory language has provided the essential elements. A more detailed section below will provide related details.

IN GREATER DETAIL

Below is described in numerical sub-sections is the financial burden-shifting hidden in SB-649, which exists regardless of whether that liability-shifting aspect is inherent in the Bill from actual intention or lucky accident: The effect of S-649 being signed into law and then the antennas deployed thereunder, will shift liability for massive numbers of cellular device injuries from industry to Government.

1. Under SB 649 and as a result of the corporate 'taking' of municipal, county, and State property, in the form of forced corporate seizure of previously publicly owned utility poles, the cellular antenna placed thereupon by such installation, including in real estate law, become an integrated 'fixture,' of said public property, in several ways legally indivisible therefrom. Other examples to the point of shared conduct imbuing with Public character arise from joint venture, etc. ***Once industry puts these antennas up on public poles, all risks and injuries from such antennas will be from a Dangerous Condition of Public Property, as defined in Government Code 835.*** The resulting Jury Instructions can be seen at CACI 1100.
2. In California law, state, regional and local governments cannot be sued for 'negligence.' Rather, the basis for which a suit may go forward against the State or an element thereof will, and must, be grounded in a statutorily prescribed Cause of

Action. Most commonly in these governmental tort situations, seasoned counsel will file, first, a Governmental Tort Claim alleging **Dangerous Condition of Public Property**, and thereafter, post-denial of the claim, the central plead liability theory of most such cases is just that, **Dangerous Condition of Public Property**, as provided for in Government Code 835.

3. It is established by clear and convincing evidence that cellular microwave broadcasts have adverse health consequences. The recent positive demonstration of the causation of malignant glioma (thus glioblastoma) cells from cellular energy in perfectly Faraday protected environments from our National Institutes of Health was only the most recent of similar and earlier findings. Much of these data and citations thereto have been provided to all Senators and Assemblymembers, including from my own letters. There can be arguments about varying danger of differing exposure routines, *but the fact that the danger exists is overwhelmingly demonstrated*, including by exposure standards for technicians engaged in cellular tower work. The epidemiological proof of non-thermal effect on the human biological system is now beyond reasonable dispute, as shown for just one example in the work of DeKun Li, the senior epidemiologist from Kaiser, Oakland, showing statistically significant increases in asthma and obesity in children of mothers who experienced higher level of EMF exposure during pregnancy. The data are readily accessible to all legislators. *With the Firefighters Exemption, the Bill itself is stating that the installation of small cell antennas on poles is "Dangerous,"* else no reason for the Exemption.
4. It is well established in publicly available records and news reports that the re-insurance industry has refused, for decades, to insure or even defend manufacturers or carriers or others in telecom against lawsuits on behalf of persons claiming to have been injured by cellular radiation exposure. Therefore, the Telecom industry, now the largest dollar industry in the world, is on the high wire without a net. **The industry likely has no insurance for injuries from cellular radiation, and it is not the proper job of the People of the great State of California to insure industry for that exposure.**
5. *In this situation, lawyers for the industry have almost certainly been tasked with examining ways through which the burden of this possible cellular injury exposure could be deflected onto other entities.* These people are too smart not to have seen this far down the road.
6. Recent news reports have speculated that SB 649 may result in as many as 50,000 new cellular towers in California; in his recent correspondence Dr. Joel Moskowitz has indicated a range of between 30,000 and 50,000: The total may not reach 50K in the near term, as there are no provisions in SB 649 to truly extend past the Divide in rural areas. If for illustration we assume the lower number, it becomes a simple math problem: LEGISLATIVELY CONFESSED DANGER x 30,000 PUBLIC POLES = 30, 000 SEPARATE INSTANCES OF DANGEROUS PIECES OF PUBLIC PROPERTY.

We have all heard allegations of people jumping on municipal transit buses immediately post crash, seeking to participate in recoveries. I think that is actually very uncommon, but recognition of tort opportunity will be easier here as these are stationary Dangerous Public Properties, which conveniently bring the carcinogenic radiation right into your living room, especially if you live in a crowded building, which with 5G exponentially expands the field density to which residents are exposed, the broadcasts not being cohesive EMF, each neighbor is affected by his or her neighbor's use of 5G.

7. Our Assembly should insist upon detailed legal analysis before passing SB 649: Under current constructions of The Telecommunications Reform Act of 1996, the companies are protected from liability, whereas it appears that the State is unlikely to benefit from the liability avoidance aspects of the 1996 Act. This is a complex area, to be further litigated, hopefully to correction for the benefit of the consumer, but there is a widely prevailing current legal view that current constructions of the Act protect the companies from any injury claims stemming from radio-frequency exposure. ***After the SB 649 cellular towers are up, and claims come forward, in any such resulting suits, until the law is more to the benefit of consumers than is currently the apparent case, where manufacturers and Telecom companies and the governmental body are all sued, and telecom can dodge out, there is a substantial legal argument the government entity involved cannot.*** This Bill sets up the State for massive losses by putting it in the place of an insurance company insuring against losses based on cellular exposure.
8. Causation will be a core issue of proof in the wave of Claims and then Complaints on this issue that is inevitable to come, given the science. Ultimate adjudication may be by Court, which is all we have at this point, or perhaps as some now visualize, something akin to the National Vaccine Injury Program, which has dispensed billions of dollars to injured claimants since its inception. Given that with the Firefighter's Exemption the State is acknowledging that its conduct of putting these antennas on every block is intentional conduct being pursued despite clear repeated science-based Notice of the risk. Here, if SB 649 goes forward, despite the repeated clear warnings of harm that have been given in submitted written records, a Court may also reasonably conclude that such further engagement in such State activity is an Extra-Hazardous Activity. The legal point that derives from this is that in Extra-Hazardous Activity the scope of Proximate Cause will be allowed to expand, a factor which puts the State at risk.

If the Assembly goes forward despite this risk, bankruptcy of the State of California can be reasonably expected to result. Just think of the testimony that we've recently heard, on July 12th, from residents who have suffered from and are still fighting brain cancer, which they attribute, with science-based cause, to extensive long term up close exposure to cellular telephony. Thus, if there is a phone-based lawsuit, where the claim derives from an area of SB 649 saturation, the lawyers involved, in order to meet the ordinary standards of care of the work, will be compelled to sue the State. It is further noted that the effective immunities enjoyed by mobile telecom service providers and manufacturers under the 1996 Act are conditional upon the device(s) involved radiating

within the FCC designated range of radiation values, yet our measurements in Palo Alto, for example, show that the strength of the allegedly 'small' cellular devices on poles there are in some instances *multiples* of the approved safety standards for human tissue saturation. In the urban context, with many households, including children, using 5G where cable used to work, most residents of dense apartment buildings will receive radiation saturation not only from what people (multiple TV's) in *their* apartment, but also from broadcast, which is not a cohesive signal, as received by nearby neighbors.

With wide-spread increasing rates of long term use, the inevitable will be put forward based upon alleged injury from a cell phone: Because of the cumulative nature of DNA damage, even with only episodic breakage increases, an upward numerical trend of DNA strand breakage percentage over time appears inevitable if SB 649 is allowed to pass. In normal balance against damaging influences, our bodies rely upon the abilities of the human biological system to self-repair, including at a DNA level, but where the capacity for repair is exceeded by direct exposure (*as distinguished from environmental exposure*) from a carcinogenic radio source, the potential for increased levels and rates of mutagenic process can reasonably be expected to occur as a result of the overwhelm of such repair capacities: Once the entire urban and suburban areas are densely saturated with so-called 'small cell' 5G (+ ?) cellular signal, and additionally given the overlapping EMF factors involved, seasoned counsel would always name the telecommunications company, the manufacturer, the seller, the service provider, and now the State, based on SB 649-rooted liability exposure. The State will be permanently exposed to liabilities so numerous and great that all other California state government programs will suffer, from roads to good policing, to schools, to public safety, to pensions.

Our laws recognize both concurrent cause, and joint and several liability where the injury resulted from multiple entities acting in concert. Joint and several liability also results in the instance of the concurring negligence of independent tortfeasors, such as in the classic Summers v. Tice context. As is not uncommon in civil lawsuits, an entity with only a tiny factual contribution to the occurrence of the liability inducing event, say 5% of the negligence pie, under Joint and Several Liability is liable for the whole quantum of the injury involved in the instance of legal unavailability of the other defendants. Therefore, if, post SB 649, there is a cellular device based lawsuit, and 5G radio-frequency saturation was present during time of injury recognition, then normal standard of care obligations, in most instances, would require the naming of that entity by name, if known, as a defendant. Due to the admitted Dangerous Condition of Public Property recognized as dangerous by the Firefighter's exemption) inherent in the melded 'small cell' 5G antenna/pole Public Property, if SB 649 passes, given Joint and Several Liability, if the companies are excluded from liability by federal law, then the State will be the full-paying defendant in such suits. Next discussed below is the question of causation, forced upon us by the looming nightmare of SB 649.

On the Subject of Causation

A science-compliant discussion of non-thermal causation of damage to people by cellular devices is forced upon us here by the incomplete physics analysis which industry lobbyists attempt to repeat in their rebuttal to claims of injury. After the Senate

Appropriations hearing which included SB 649, I was approached in the corridor by a lead lobbyist from a very major telecom company. He said to me, I paraphrase ". . .you know, Mr. Lehmann, in order to affect tissue molecules without heat, you have to move the neutrons . . .and there's not enough energy in cellular signal to affect those neutrons."

The above-described exchange with this lobbyist is described in the 14 page letter and sworn Declaration that Mr. McGavin and I presented to the Senate Appropriations Committee. That kindly lobbyist was actually mis-stating the company line: Contrary to the above lobbyist's remarks, the long-stated industry position has not been about 'neutrons,' but rather that: 1) Cellular non-ionizing radiation doesn't have enough energy to directly modify an electron's shell position in an atom, *so that the valence of that atom cannot by such cellular radiation be directly changed*, and: 2) Therefore direct, non-thermal DNA damage to human tissue is not possible from cellular radiation because the energy involved is not sufficient to occasion molecular re-combination except via heat.

The industry position on the disclosed part of their physics to chemistry argument makes sense: That there is not enough energy in current or anticipated civilian cellular radiation to cause an electron to jump a shell position. However, this electron-shell-no-can-go routine is defective in its predicate: The industry position, choir sung by most industry engineers (not the late great Robert C. Kane), is predicated upon the incorrect assumption that the only mechanism of non-thermal damage is ionic forced change, meaning situations in which so much energy is by radiation placed into the molecules involved that over-loading of charge forces electron migration resulting in molecular re-combination, experienced as tissue damage.

Ionic-forced-immediate-direct chemical change, which *does* occur with ionizing radiation, does not occur with less powerful non-ionizing radiation from cellular devices. However, clear science shows that DNA strand breakage is occurring from the non-ionizing radiation from these sources. As you likely know, it is well proven scientifically that high frequency sound can, for example, shatter glass. The data indicate that DNA breakage is resulting from mechanical vibration of the DNA molecule as DNA molecules dissipate the energy which is undeniably pumped into them via radio-frequency EMF. In this regard, the 1983 interferometer findings of Swicord and Brown at the University of Maryland were mentioned in the 14 page compendium which submitted to Senate Appropriations, containing my 7 page letter and Mr. McGavin's Declaration, under Penalty of Perjury, which was also 7 pages, and which 14 page letter to Senator Lara, dated May 23rd, is integrated herein by this reference as though more fully set forth herein. It was found by Swicord/Brown's work that the addition of DNA salts to plain water, to a 7.43 percentage in the resulting fluid, ***caused a twenty-four fold increase in Specific Absorption Rate, and that this massive 24X change was non-ionic***, but rather 'acoustic,' meaning as a result of the mechanical receipt of vibration energy from the cellular frequency by the DNA molecular structure.

Swicord and Brown, as stated in their paper on their interferometer testing of SAR levels, were verifying prior peer-reviewed projections that this level of SAR change in DNA would result. It is my current understanding that Dr. Swicord was at FDA when that agency, which usually passes judgement on radiation-generating consumer products,

exempted cell phones, and then, as I understand it as informed opinion, Dr. Swicord lived out his remaining career at Motorola. So, bottom line, we have extreme vibrational change in DNA from cellular range radiation, namely a drastic 24 fold increase in Specific Absorption Rate. The importance of this repeated finding is best illustrated by the work of Dr. Henry Lai, when this work was published he was with the University of Washington School of Medicine I heard Dr. Lai's presentation of his experimental findings at the International EMF Conference in Stavanger, Norway, in late 2009, and later in Norway was honored to travel to and reside for a while in the mountains over Bergen with the world's top scientists in this field, including people at the level of Dr. Martin Blank of Columbia and Dr. Olle Johansson of the Karolinska Institute, Stockholm.

Dr. Lai's experiments unequivocally proved the fact of DNA strand breakage from cellular telephone radiation. So, once the reader understands that: 1) Through the interferometer work of Swicord and Brown at Maryland, 1983, that DNA change occurs via acoustic means, while also understanding that: 2) The work of Dr. Lai, showing that such cellular signal causes DNA breakage, then it may be responsibly suggested that the occurrence of DNA breakage, not by ionic means, but via acoustic receipt of the vibrational energy. That's how people are getting hurt. Plus the calcium ion findings, noted, supra, from the elegant work of Dr. Pall at the Washington State University, and propriety requires the mention of the ground breaking work of Dr. Andrew Galsworthy of Imperial College London, whose pioneering work regarding the stripping action of cellular and other microwave on intra-cellular calcium is forth in Dr. Galsworthy's March 2012 paper The Biological Effects of Weak Electromagnetic Fields - Problems and Solutions. As to vibrational fracture of the DNA molecule, see *also Electrosmog and autoimmune disease*, by scientists Trevor G. Marshall and Trudy J. Rumann Heil. The core point sought to be communicated here is that the industry dirge; 'it can't be us, cause non-ionizing radiation can't force an ionic change,' is an incomplete as an analysis of cell damage causation, because it is a red herring of belief that has distracted the busy from seeing the actual causation.

Many environmental influences can contribute to the formation of the more serious illnesses. The book *The Secret History of the War On Cancer*, by epidemiologist Dr. Devra Davis is the best available professional source towards an understanding of the relationships between industrial toxins and health patterns in the population. This section on Causation is here only because the industry excuse sheds less light than smoke. By background, I have practiced trial based law for four decades, specializing in engineering and scientific proof cases since 1983. After the deaths of four friends and colleagues from brain cancer, I became a student of the EMF issues, to which issues myself and many others are dedicated to public education, including through our ongoing work at Green Swan, Inc.

SB 649 Seeks to Keep Cellular Telecom Off The Ropes at California's Expense.

Telecom is giant and powerful, but the truth, science, ethics and the law are far more important than the \$1.43 trillion that industry has poured into lobby efforts since 1998 (www.opensecrets.org). But even with all its massive funding, the industry has not been able to buy insurance for this industry regarding potential mobile phone casualties.

The re-insurance industry, giants like Zurich, Lloyds, long ago announced that they would not insure for personal injuries caused by cellular devices. As a result the telecom companies are at this point on their own. If they don't shift liability responsibility to another entity or entities, they face massive and potentially ruinous. Perhaps this led to a multiple stage, difficult to see legal tactic of risk shifting to the public. If something like this were going on, it would all of a sudden make a lot of sense if there were an *extreme rush* placed on this legislation. Senate Bill 649 mimics legislation that the industry tried to get through the federal Senate (S-19), which didn't work out for them, it was placed on Hold at the end of March, where it now remains, *and directly thereafter commenced this massive hard push to get California on board with the same 'seize the light poles' effort, to which obviously immense professional lobby effort is being devoted to an ongoing ongoing push for fast passage.* Normally, we could say, 'well, that's life, sometimes you've got to let the big dog eat.' But this situation is very different from ordinary because lives and souls are at stake here. This isn't a game or a hobby, this is serious.

Whether planned or not, after infrastructure is established resulting from SB 649, one crucial result *is to transfer the financial burden of impending severe liability exposure from the industry to the government.* In the instance of S-19, a substantially duplicate Bill now sensibly remaining on Hold at the federal Senate, the transference of liability exposure would have been to the federal government. With the failure of S-19 at the federal level the telecom industry went immediately to work in California. With the telecom industry having consumed a great feast at the restaurant of commerce, the effect of signing SB-649 into law would be to stick California with the tab for that very feast.

Lawmakers in California to insure that any legislation which is passed will not harm the public. Any member of our Legislature who, *knowing that there is scientific evidence of harm*, votes for SB 649 will be no different than those in power over Flint Michigan, who knew of the health hazards in the water, and yet allowed that public health hazard to continue. However, in terms of the number of people to be severely harmed, the situation with SB 649 is far more severe even than what tragically happened in Flint.

Very truly yours,



Harry V. Lehmann

Transmission Log

LEHMANN LAW OFFICE

Wednesday, 2017-07-19 09:52

14158986959

Date	Time	Type	Job #	Length	Speed	Station Name/Number	Pgs	Status
2017-07-19	09:50	SCAN	02278	2:11	21600	9163192181	10	OK -- V.34 1B31

Harry Vere Lehmann,
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
P. O. Box 1846
Novato, California 94948-1846

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via facsimile of even date and Federal Express.

July 19, 2017

Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee
State Capitol, Room 2114
Sacramento, CA 95814
Via 10 page fax: 916-319-2181
& Federal Express overnight

- Re:
1. Incorrect data given in Telecom testimony regarding Liability: The State faces liability exposure from SB 649
 2. Whether exquisitely planned for this inevitable result, or 'just lucky' for Telecom, SB 649 once deployed will have the effect of shifting massive Industry liability to the State of California.

Dear Ms. Galehouse -

The liability-shift component of the SB 649 issue set has not been previously addressed. I didn't see the underlying liability-shift until after the testimony last Wednesday. The liability-shift consequence of SB 649 is a difficult point to see, but essential to be recognized. This letter is divided into two sections, the **GENERAL OVERVIEW** which appears next below presents the gist in three pages, and then a larger section titled **IN GREATER DETAIL**. Because the liability shifting aspect of this analysis was not seen by the undersigned until after the close of testimony on July 12th, and because the Appropriations Committee hearing on SB 649 is only a week away, and because this analysis implies possible billions in losses to the State, an Appropriations issue, this is an initial overview of the situation in the expectation that seasoned and competent unbiased legal analysis will be made of the most startling of the two issues here addressed, before passage of this Bill: In-depth legal analysis is encouraged.

GENERAL OVERVIEW

This letter reaches the conclusions stated through several vectors of analysis but bottom line this boils down to two core points: **1.** During the hearings on SB 649, assurances were given by industry that the telecom companies would be the only entities affected by liability from radiation injuries. That is not true. Rather and instead, through SB 649 California faces potential liability for any injuries claimed to have resulted from the allegedly 'small cell,' antennas delivered to our residents from SB 649. **2.** More profound in implication if true, and difficult to see, **there is a heretofore non-disclosed sequella from SB 649; the potential transfer all financial liability for cellular injury cases from the telecom corporations to the State.**

Harry Vere Lehmann
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via fax: 916-319-2181

August 24, 2017

The Hon. Assemblymember Lorena Gonzalez-Fletcher, District 80
Chair, Assembly Appropriations Committee,
Care Of: Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee

RE: Due to multi-axial EMF crossfire, SB 649 will disproportionately injure the poor, in District 80, and in the rest of urban and suburban California.

Dear Assemblymember Gonzalez-Fletcher:

Due to multi-axial overlapping signal saturation, if SB 649 is enacted as intended, the negative health consequences will fall disproportionately upon the poor. Below are relevant factors supporting this fact:

1. One goal of installing 50,000 new cellular distribution antennas is that 5G customers will be able to receive the digital entertainment now provided by cable through the 5G network.
2. The cellular broadcast signals from these incorrectly-labeled 'small cell,' microwave transmitters are not cohesive, but rather spherical; not like a laser, more like a lightbulb.
3. With the 5G approach a single local microwave broadcast antenna can carry many different programs simultaneously.
4. When non-coherent broadcasts are from the same or nearby towers, their signals will overlap, think of overlapping 3D Venn Diagrams, or like a yard lit by lights of many different colors from the same pole.
5. It is therefore unavoidable that such differing signals from the same (or separate and nearby local) 'small cell' 5G antennas will overlap.
6. The result of overlapping of non-coherent radio-frequency broadcasts is expanded signal concentration, ***with an increase in received signal density proportional to the proximity of recipient sites to each other.***

7. Anyone familiar with the lives of our more recently arrived Hispanic residents knows that their living situations tend to be more dense than the density experienced by financially secure residents. People of all races who live in assisted circumstances are in the same situation: The square footage in apartment units is proportional to what can be afforded.
8. For example, if on any given evening at 8 p.m. there are 16 units in an apartment building, and each one is viewing 5G digital entertainment, ***then all 16 units will be saturated from each of the non-coherent broadcasts being made from the 'small cell' antenna(s) involved.***
9. While there will also be increased signal density in apartments occupied by well-to-do residents, the radiation saturation experienced by the poor will be greater, because the units are closer together.
10. Poorer residents, in addition to living in more tightly packed units, due to financial circumstance will sometimes live with more people in each unit than the well-to-do. With 5G entertainment, an increase in people using tablets in any given also increases saturation density.
11. Well established science already supplied to Appropriations shows that cellular radiofrequency non-ionizing radiation causes harm to the human biological system, including glioblastoma, and that this harm is caused in part by breakage of the DNA molecule strands as well as disruption of cellular calcium ion utilization. Even 'ordinary' single unit cellular phones will cause a kill-off of 50% of the sperm in a male who keeps a cellular device in his front pants pocket. A recent Israeli study showed a kill-rate at 47%. The poor will be hurt worse than people who live in single family homes far from the streets.

The above noted effects are not tied to race but they ***are*** tied to money and resulting density of occupation. People who are living in the most congested circumstances will experience far greater levels of signal density. My father was a truly great man who worked as a school custodian in his later years and I was working full time in a restaurant while a freshman in high school. I am glad to still see the world in many ways with the eyes of a person from the serving classes. This is a time when each of us, regardless of background, should recognize that the deployment of so-called 'small cell' 5-G will hurt the poor more than the rich. As a lawyer and as CEO of Green Swan, our advocacy company, I volunteer to debate this with whatever lawyer the telecom industry wishes to sacrifice for that process.

Very truly yours,



Harry V. Lehmann, as a lawyer
and as CEO of Green Swan, Inc.

Transmission Log

LEHMANN LAW OFFICE

Thursday, 2017-08-24 10:13

14158986959

Date	Time	Type	Job #	Length	Speed	Station Name/Number	Pgs	Status
2017-08-24	10:12	SCAN	02311	0:24	24000	9163192181	2	OK -- V.34 1B31

Harry Vere Lehmann
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via fax: 916-319-2181

August 24, 2017

The Hon. Assemblymember Lorena Gonzalez-Fletcher, District 80
Chair, Assembly Appropriations Committee,
Care Of: Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee

RE: Due to multi-axial EMF crossfire, SB 649 will disproportionately injure the poor, in District 80, and in the rest of urban and suburban California.

Dear Assemblymember Gonzalez-Fletcher:

Due to multi-axial overlapping signal saturation, if SB 649 is enacted as intended, the negative health consequences will fall disproportionately upon the poor. Below are relevant factors supporting this fact:

1. One goal of installing 50,000 new cellular distribution antennas is that 5G customers will be able to receive the digital entertainment now provided by cable through the 5G network.
2. The cellular broadcast signals from these incorrectly-labeled 'small cell,' microwave transmitters are not cohesive, but rather spherical; not like a laser, more like a lightbulb.
3. With the 5G approach a single local microwave broadcast antenna can carry many different programs simultaneously.
4. When non-coherent broadcasts are from the same or nearby towers, their signals will overlap, think of overlapping 3D Venn Diagrams, or like a yard lit by lights of many different colors from the same pole.
5. It is therefore unavoidable that such differing signals from the same (or separate and nearby local) 'small cell' 5G antennas will overlap.
6. The result of overlapping of non-coherent radio-frequency broadcasts is expanded signal concentration, **with an increase in received signal density proportional to the proximity of recipient sites to each other.**



Assembly Member Miguel Santiago
Chair of the Communications and Conveyance Committee
P.O. Box 942849
Sacramento, CA 94249-0053
RE: SB 649 Wireless and Small Cell Telecommunications Facilities (amended 7/3/2017)
Strongly oppose

Dear Assembly Member Miguel Santiago,

EMF Safety Network¹ and Ecological Options Network² strongly oppose SB 649 regarding telecommunications facilities. SB 649 eliminates local zoning authority, conflicts with federal and other laws, and increases harmful radio frequency radiation (RFR). International independent scientists are calling for reducing RFR based on peer reviewed published science showing RFR harms the public and nature, and children are especially vulnerable.

SB 649 abandons the public to trust the telecom industry to certify safety and RFR compliance with federal laws.

1) SB 649 eliminates local authority

SB 649 will allow a ministerial permit for antenna siting for the majority of local governments. This over the counter permit will gift multiple companies unlimited access to deploy unlimited antennas in our neighborhoods and countrysides. Local authority is

¹ EMF Safety Network (EMFSN) was founded in 2009. Our mission is to educate and empower people by providing science and solutions to reduce EMFs, achieve public policy change, and obtain environmental justice. We have participated in proceedings at the California Public Utilities Commission since 2010. www.emfsafetynetwork.org

² Ecological Options Network(EON) was founded in 2003, is a 501 (c) (3) organization that networks with utility customers and organizations to empower policy protecting health, environment and consumer rights. <http://www.eon3.net/>

needed to ensure community safety and welfare³, and compliance with federal laws⁴. SB 649 would overturn a recent California court case where San Francisco won the right to determine antenna placement. The court discussed in detail and ruled Public Utilities Codes 7901 and 7901.1 did not limit a city's right to design review.⁵ SB 649 conflicts with California Public Utilities Commission (CPUC) no and low cost EMF avoidance policy⁶ adopted in 1993. In 2006 the CPUC upheld the policy, which included RFR.⁷

2). SB 649 conflicts with federal laws

The Federal Telecommunications Act of 1996 preserves local zoning authority, and requires compliance with environmental laws and RFR safety rules. An over the counter permit would conflict with RFR compliance required by federal Law.

According to the Federal Communications Commission(FCC) website⁸:

- *“Building a new tower or collocating an antenna on an existing structure requires compliance with the Commission’s rules for environmental review. These rules ensure that licensees and registrants take appropriate measures to protect environmental and historic resources, and that the agency meets its obligations under the National Environmental Policy Act (NEPA) to consider the potential environmental impact of its actions, as well as under other environmental statutes such as the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA).”*
- “NEPA requires agencies to consider and disclose the environmental effects of its actions to improve decision-making and encourage transparency, public participation, and accountability. Effects are defined broadly to include ecological, aesthetic, historic, social, and cumulative and indirect effects.”

³ Cal. Const., art. XI, §7 “A county or city may make and enforce within its limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws.”

⁴ FCC Tower and Antenna Siting: <https://www.fcc.gov/general/tower-and-antenna-siting>

⁵ T-Mobile West vs City and County of San Francisco (Appeal denied): <http://www.gmsr.com/wp-content/uploads/2017/02/scw-A144252M.pdf>

⁶ CPUC actions regarding EMFs <http://www.cpuc.ca.gov/environment/emf/actions.htm>

⁷ CPUC D.06-01-042.

⁸ FCC Tower and Antenna Siting: <https://www.fcc.gov/general/tower-and-antenna-siting>

- “Collocations, including Distributed Antenna Systems (DAS) and Small Cells, may also require compliance with these same processes.”
- “Section 332(c)(7) of the Communications Act preserves state and local authority over zoning and land use decisions for personal wireless service facilities, but sets forth specific limitations on that authority.” ...”The statute also preempts local decisions premised directly or indirectly on the environmental effects of radio frequency (RF) emissions, assuming that the provider is in compliance with the Commission’s RF rules.”

The fact that these antennas are called “small cell” does not mean they comply with the FCC rules quoted above. The FCC calculates RFR by what the public’s exposure levels are, including frequencies, radiated power, and distance.

For example:

- *What frequencies will be used?*
- *What is the radiated power at the source?*
- *How many antennas are in one enclosure?*
- *What is the exposure level at ground level? at 20 feet? at 100 feet?*
- *What is the existing cumulative RFR exposure level at ground level? at 20 feet? at 100 feet?*
- *Is the ground flat or falling? If not, what are the exposure levels at what height and distance?*
- *What is the future collocation RFR exposure?*

SB 649 also conflicts with federal law (Section 6409) which exempts cities from antenna modifications on city property.⁹

3) California Environmental Quality Act (CEQA) laws apply

The deployment of a denser “small cell” antenna system is a major change to the environment, not a minor one, and therefore subject to CEQA laws. There is no substantial evidence to support SB649’s determination that the deployment fits the CEQA exemption. There is substantial evidence in support of a fair argument that the

⁹ Best Best and Kreiger FCC’s Wireless Facility Rules Implementing Section 6409(a) pdf p.15 2015 http://sananselmo-ca.granicus.com/DocumentViewer.php?file=sananselmo-ca_8397b41675b5de650a27df9d779ecbd7.pdf

project may create environmental impacts. Whenever it can be fairly argued on the basis of substantial evidence that there is a reasonable possibility that a project may have a significant effect on the environment, an exemption is not proper.

4) Telecoms' interests should not outweigh city and county jurisdiction

"Telecoms want customers... Wireless service has become essential... for better quality of life." These claims were part of the supporters testimony at the Local Government Committee hearing on June 28, 2017. Not all Californians want their homes, neighborhoods, towns, and rural country-sides to be polluted with RFR. Telecom deployment serves the unbounded profit motive of telecom corporations. What is in the best public interest is to avoid unnecessary RFR exposures. There is a growing movement of educated Americans who are aware of cancer and other health impacts associated with RFR. In California tens of thousands of utility customers have refused, or opted out of smart meters. Significant percentages of people, those already sickened, and those trying to avoid being injured, adamantly oppose being involuntarily exposed to more radiation for benefit of telecommunications profits. Access to the internet is safer using wired connections. Wireless is not an essential public service.

5) The FCC historically honors local control

On July 14, 2016 FCC Commissioner Jessica Rosenworcel stated during her approval of 5G millimeter wave deployment, "***By law and tradition we honor local control in this country.***"¹⁰ SB 649 should be opposed because it will dishonor and impede local control and deliberately thwart public participation. We support the comments of The League of California Cities who state SB 649, "*unnecessarily and unconstitutionally strips local authority over public property and shuts out public input and local discretion by eliminating consideration of the aesthetic and environmental impacts of "small cells."*

6) SB 649 increases harmful RFR exposure to humans and nature.

International independent scientists are calling for immediate measures to reduce RFR. Peer reviewed, published science shows RFR poses serious health and safety impacts

¹⁰ At 19: 27 <https://www.fcc.gov/news-events/events/2016/07/july-2016-open-commission-meeting>

to the public and nature. Children are more vulnerable.

- 224 scientists have signed the International EMF Scientist Appeal: *“We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include—but are not limited to—radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF).”* *“Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans.”*¹¹ Scientists quotes:
 - *“Based upon epidemiological studies there is consistent evidence of increased risk for brain tumors (glioma and acoustic neuroma) associated with use of wireless phones.”* Lennart Hardell, MD, PhD University Hospital, Orebro, Sweden
 - *“The harmful effects of electromagnetic fields, regardless of their frequencies, are now scientifically settled. Pregnant women (the fetus) and children and adolescents are particularly vulnerable.”*- Dominique Belpomme, MD, MPH, Paris V Descartes University, European Cancer & Environment Research institute.
 - *“Migratory birds -- incredibly important to the global economy and for the ecological services they provide -- now appear to be negatively affected by non-ionizing radiation.”* Dr. Albert Manville, Adjunct Professor, Johns Hopkins University; Senior Wildlife Biologist, U.S. Fish & Wildlife Service (FWS), Emeritus/Retired
- The National Toxicology Program published a 25 million dollar study which is one of the largest and most comprehensive studies on cell phone radiation and cancer. In

¹¹ EMF Scientist appeal <https://www.emfscientist.org/index.php/emf-scientist-appeal>

the study the rats exposed to cell phone radiation developed two types of cancers, glioma, a brain tumor, and schwannoma, a tumor in the heart. The summary includes, “Given the widespread global usage of mobile communications among users of all ages, even a very small increase in the incidence of disease resulting from exposure to RFR could have broad implications for public health.”¹²

- The BioInitiative Report updated in 2012, prepared by 29 authors from ten countries, reviewed 1800 studies and conclude, “EMF and RFR are preventable toxic exposures. We have the knowledge and means to save global populations from multi-generational adverse health consequences by reducing both ELF and RFR exposures. Proactive and immediate measures to reduce unnecessary EMF exposures will lower disease burden and rates of premature death.”¹³
- The International Agency for Research on Cancer at the World Health Organization classifies RFR as a 2B (possible) carcinogen.¹⁴

7) Peer reviewed published studies show proximity to antennas is hazardous.

Neurobehavioral effects among inhabitants around mobile phone base stations “The prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls...”¹⁵

- Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations “We found that eight of the 10 studies reported increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances < 500 meters from base stations.”¹⁶

¹² NTP cell phone study <http://ntp.niehs.nih.gov/results/areas/cellphones/index.html>

¹³ Bioinitiative Report <http://www.sciencedirect.com/science/journal/09284680/16/2-3>

¹⁴ IARC/WHO <https://goo.gl/BrkpG8>

¹⁵ Neurobehavioral effects among inhabitants around mobile phone base stations <https://www.ncbi.nlm.nih.gov/pubmed/16962663>

¹⁶ Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations <https://goo.gl/Zz6dhk>

8) Future cell tower plans are for 5G which emits millimeter waves. Peer reviewed published science shows millimeter waves penetrate the skin and affect human health.¹⁷ Millimeter wave technology has been developed as a crowd control weapon which causes acute burning pain, as if the body is on fire.¹⁸

- An analysis of studies on millimeter waves (MMWs) “State of knowledge on biological effects at 40–60 GHz”¹⁹ states, *“At the cellular level, it stands out from the literature that skin nerve endings are probably the main targets of MMWs and the possible starting point of numerous biological effects.”* Effects reviewed include effects on capillaries and nerve endings, protein insults, epigenetic regulation, and the risk of homeostasis disruption, which would have dramatic consequences.

9) Peer reviewed published studies show RFR exposure harms nature.

- The US Department of the Interior states RFR threatens birds, and they criticize the FCC’s radiation safety guidelines stating, *“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.”* Two hundred forty one bird species are at mortality risk from both tower collisions and from exposure to the radiation towers emit. This includes birds that are endangered or threatened, Birds of Conservation Concern, migratory birds, and eagles. Studies of radiation impacts on wild birds documented nest abandonment, plumage deterioration and death. Birds studied included House Sparrows, White Storks, Collared Doves, and other species. Studies in laboratories of chick embryos documented heart attacks and death.²⁰
- Scientists in Germany studied tree damage in relation to electromagnetic radiation from 2006-2015. They monitored, observed and photographed unusual or unexplainable tree damage, and measured the radiation the trees were exposed too. *“The aim of this study was to verify whether there is a connection between*

¹⁷ State of knowledge on biological effects at 40–60 GHz <https://goo.gl/gbBKHL>

¹⁸ US Military Active Denial System <http://jnlpw.defense.gov/About/Frequently-Asked-Questions/Active-Denial-System-FAQs/>

¹⁹ C. R. Physique 14 (2013) 402–411

²⁰ US Department of Interior letter and background: http://www.ntia.doc.gov/files/ntia/us_doi_comments.pdf

unusual (generally unilateral) tree damage and radiofrequency exposure.” They found significant differences between the damaged side of a tree facing a phone mast and the opposite side, as well as differences between the exposed side of damaged trees and all other groups of trees in both sides. They found no tree damage in low radiation areas. The scientists concluded, *“Statistical analysis demonstrated that electromagnetic radiation from mobile phone masts is harmful for trees.”*²¹

- Studies show insects are harmed by radiation: Food collection and response to pheromones in an ant species exposed to electromagnetic radiation found exposure to radiation caused colony deterioration and affected social insects’ behavior and physiology.²² Oxidative and genotoxic effects of 900 MHz electromagnetic fields in the earthworm concluded radiation caused genotoxic effects and DNA damage in earthworms²³.
- Mobile Phone Induced Honey Bee Worker Piping. The study abstract states, *“The worldwide maintenance of the honeybee has major ecological, economic, and political implications.”* Cell phone RFR was tested for potential effects on honeybee behavior. Handsets were placed in the close vicinity of honeybees and the sound made by the bees was recorded and analyzed. The information revealed that active cell phone handsets induced the bees worker piping signal. *“In natural conditions, worker piping either announces the swarming process of the bee colony or is a signal of a disturbed bee colony.”*

²¹ Radiofrequency radiation injures trees around mobile phone base stations. <https://www.ncbi.nlm.nih.gov/pubmed/27552133?dopt=Abstract#>

²² Food collection and response to pheromones in an ant species exposed to electromagnetic radiation <https://www.ncbi.nlm.nih.gov/pubmed/23320633>

²³ Oxidative and genotoxic effects of 900 MHz electromagnetic fields in the earthworm *Eisenia fetida*. <https://www.ncbi.nlm.nih.gov/pubmed/?term=23352129>

SB 649 is an unnecessary gift to the telecom industry.

Respectfully submitted on July 6, 2017:

/s/
Sandi Maurer, Director
EMF Safety Network
PO Box 1016
Sebastopol CA 95473

/s/
Mary Beth Brangan, Co-Director
Ecological Options Network
PO Box 1047
Bollinas CA 94924