Discussion and Evidence Regarding
Low Level RF Radiation Induced Biological Health Effects

A. Current RF Exposure Guidelines and Implications of the IARC Declaration

No human health impact studies were conducted prior to the wide-scale deployment of wireless technologies in our society. From an industry perspective, safety claims are made based upon claims that RF emissions from individual devices comply with outdated Federal Communications Commission (FCC) or comparable ICNIRP exposure guidelines. Unfortunately, FCC and ICNIRP exposure guidelines were never formulated to fully protect human health. In fact, they are only believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn over a timeframe of several minutes of exposure (i.e., through the so-called thermal mechanism). FCC exposure guidelines have no biological relevance to protect humans from low level chronic exposure to RF radiation emitted by devices such as wireless smart meters, Wi-Fi routers, Wi-Fi enabled laptops, etc.

In May 2011 at the meeting at the Headquarters of the International Agency for Research on Cancer (IARC) in Lyon, France, the Working Group of 30 scientists nearly unanimously declared radiofrequency (RF) radiation as a *possible carcinogen*. This declaration has effectively been ignored by the scientific establishment and certainly ignored by the promoters of wireless technologies.

The decision to classify RF radiation as *possibly carcinogenic* was based predominantly on the results of the Interphone study and studies of the Swedish group of Hardell, showing that long term extensive use of cell phones increases the risk of developing brain cancer.

This means that the possible health effect of cancer developed in people using regular cell phones, compliant with current FCC or ICNIRP radiation emission safety guidelines. Objectively, one can then conclude that non-thermal health effects exist because cell phones meeting current safety guidelines do not induce thermal effects. It further means that current RF exposure guidelines are insufficient because the amount of radiation emitted by the cell phones causes an increased health risk of developing cancer. Once one accepts that FCC or ICNIRP guidelines are insufficient for protection for cell phone radiation, we have no assurance that such guidelines are then acceptable for any other wireless devices.

Beyond the actual IARC declaration of RF radiation being *possibly carcinogenic* to humans, there is an important paragraph contained in the full

IARC Monograph, Volume 102, for non-ionizing radiation (and radiofrequency electromagnetic fields), published April 2013:

> "Although it has been argued that RF radiation cannot induce physiological effects at exposure intensities that do not cause an increase in tissue temperature, it is likely that not all mechanisms of interaction between weak RF-EMF (with the various signal modulations used in wireless communications) and biological structures have been discovered or fully characterized. Biological systems are complex and factors such as metabolic activity, growth phase, cell density, and antioxidant level might alter the potential effects of RF radiation. ***Alternative mechanisms will need to be considered and explored to explain consistently observed RF dependent changes in controlled studies of biological exposure***." [emphasis added]

The above paragraph is an acknowledgment that RF induced changes are occurring in controlled studies which cannot be explained through a thermal mechanism, … the only mechanism accepted by the ICNIRP. Because of this IARC acknowledgment and the fact the current exposure guidelines are known to only protect against thermal RF-related effects, there is clear justification to implement a precautionary approach with regard to further expansion of wireless technologies until further research is completed or new biologically based exposure standards are established.

B. The President's Cancer Panel

According to the "President's Cancer Panel" report [1] entitled *Reducing Environmental Cancer Risk*, issued in April 2010, RF radiation was categorized to be "suspected" as carcinogenic, and that "a causal link is based on the authors' assessment that results of epidemiologic studies are mixed, yet positive findings from well-designed and conducted studies, including animal studies warrant precautionary action and additional scientific investigation."

The report recommends that a precautionary, prevention-oriented approach be taken to replace our current reactionary approach to regulating environmental contaminants in which human harm must generally be proven before action is taken to reduce or eliminate exposure. Selected quotations are provided below:

- "Industry has exploited regulatory weaknesses, such as government's reactionary (rather than precautionary) approach to regulation."
- "An alternative approach to regulation that supports primary cancer and other disease prevention is precautionary."
- "When credible evidence exists that there may be a hazard, a precautionary approach should be adopted and alternatives should be sought to remove the potential hazard and still achieve the same social

benefit. Such an approach acknowledges the uncertainty of identifying cancer risks in complex, poorly understood environmental systems."

- "A precautionary, prevention-oriented approach should replace current reactionary approaches to environmental contaminants in which human harm must be proven before action is taken to reduce or eliminate exposure."

[1] "President's Cancer Panel" report, April 2010, *Reducing Environmental Cancer Risk*; refer to link at: http://deainfo.nci.nih.gov/ADVISORY/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf.

C. French ANSES Expert Appraisal on Radiofrequencies and Health

Another document that supports the existence of RF induced biological effects is the French agency report in October 2013. Although the full report is written in *French*, a summary report was made available in *English*.

The French health agency, ANSES, published results of its assessment of risks related to exposure to radiofrequencies based upon a review of the international scientific literature. The introductory statement for the ANSES summary document includes the following:

> ***"Faced with the rapid development of wireless technologies, ANSES issues recommendations for limiting exposure to radiofrequencies, especially for the most vulnerable populations."***

Continuing with additional information from the French governmental agency announcement:

> "Limited levels of evidence do point to different biological effects in humans or animals. In addition, some publications suggest a possible increased risk of brain tumour, over the long term, for heavy users of mobile phones. Given this information, and against a background of rapid development of technologies and practices, ANSES recommends limiting the population's exposure to radiofrequencies – in particular from mobile phones – especially for children and intensive users, and controlling the overall exposure that results from relay antennas. It will also be further developing its work on electro-sensitive individuals, specifically by examining all the available French and international data on this topic that merits closer attention."

The following additional statement is contained within the French agency announcement:

> "The findings of the risk assessment have not brought to light any proven health effects." [emphasis added]

The word proven is generally interpreted to mean: "Having been demonstrated or verified without doubt." Well, almost nothing can be "verified without doubt" in science or medicine. So while the French announcement includes the statement that health effects have not been "proven," the French "expert appraisal" should be considered a major development where a governmental agency of a major Western country appears to be turning in favor of prudent avoidance of RF emissions in the interests of protecting public health and safety.

The French health agency announcement continues:

> "The findings of this expert appraisal are therefore consistent with the classification of radiofrequencies proposed by the World Health Organization's International Agency for Research on Cancer (IARC) as '*possibly carcinogenic'* for heavy users of mobile phones. ***In addition***, the expert appraisal nevertheless shows, with limited levels of evidence, different biological effects in humans or animals, … these can affect ***sleep, male fertility or cognitive performance***." [emphasis added]

Although the French health agency uses cautious language in indicating that adverse health effects have not been "proven," the clear headline for the report is that an agency of the French government is recommending a ***precautionary approach*** to complement the limits based system that exists for limiting RF exposure within France.

D. Indian "Expert Committee to Study the Possible Impacts of Communication Towers on Wildlife Including Birds and Bees"

In 2011, the government of India constituted an expert committee to study the possible impacts of communication towers on wildlife including birds and bees.

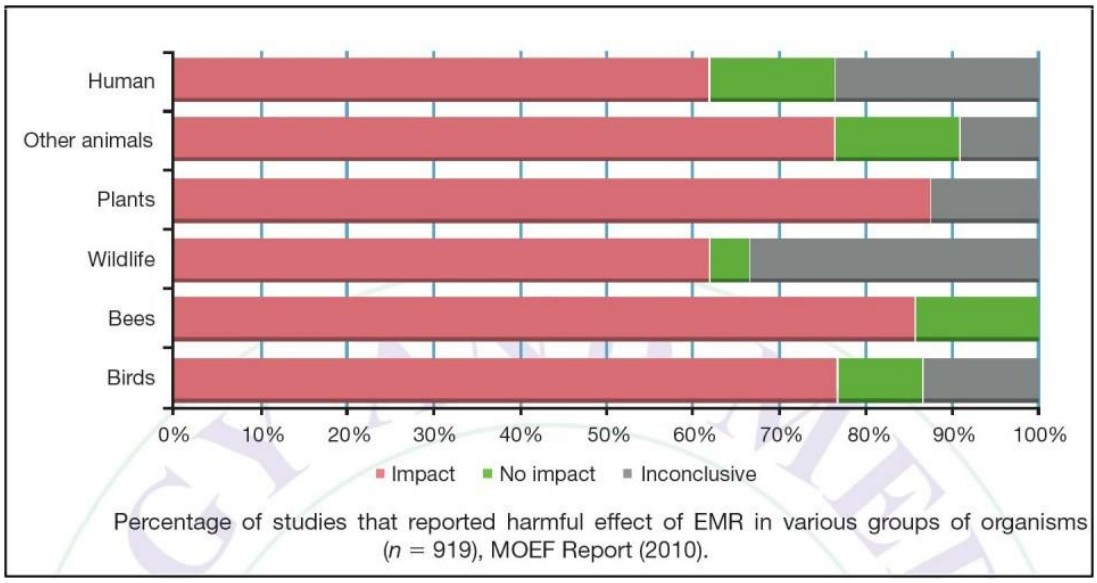
The report prepared by the government of India concluded:

> "The review of existing literature shows that the EMRs are interfering with the biological systems in more ways than one and there had already been some warning bells sounded in the case on bees and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other species as well. Despite a few reassuring reports, a vast majority of published literature indicate deleterious effects of EMFs in various species."
>
> "Microwave and radiofrequency pollution appears to constitute a potential cause for the decline of animal populations and deterioration of health of plants and humans living near radiation sources such as phone masts. Studies have indicated the significant non-thermal long-

term impacts of EMFs on species, especially at genetic level which can lead to various health complications including brain tumours (glioma), reduction in sperm counts and sperm mobility, congenital deformities, psychiatric problems (stress, 'ringxity', sleep disorders, memory loss etc.) and endocrine disruptions. However similar aspects are yet to be studied among animal populations."

"Well-designed long-term impact assessment studies would be required to monitor the impact of ever-increasing intensities of EMRs on our biological environment. ***Meanwhile the precautionary principle should prevail*** and we need to better our standards on EMF to match the best in the world." [emphasis added]

The Indian government report concluded that out of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies. A summary table is shown below.



Percentage of studies that reported harmful effect of EMR in various groups of organisms (n = 919), MOEF Report (2010).

Within India, both the State of Rajasthan and the City of Mumbai have passed laws prohibiting the placement of cellular antennae on the roofs of hospitals and schools and in playgrounds because they are "hazardous to life." Even the Indian Supreme Court has held that the radiations are hazardous and rejected an appeal filed against an interim order for relocation of towers away from schools. The bench relied upon the inter-ministerial meeting of central government of India in May 2012, wherein it was emphasized that the electromagnetic radiations emitted from cellphones as well as towers erected for mobile communication have both thermal and non-thermal effects. It has further been held on the basis of report of the inter-ministerial committee that RF radiations are harmful, causing cancer, brain tumors, digestive disorder, tachycardia, and other diseases and disorders in the human body.

Furthermore, the Indian court stated that a mobile phone should not be used for more than 20-25 minutes per day but that consumers were not being made aware of this fact by the mobile manufacturing as well as service providing company, and for which mass awareness is required.

[Source article at the following link: http://www.deccanherald.com/content/294813/no-mobile-towers-near-schools.html]

E. Analyzing Arguments Like Those Made by the ICNIRP

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) in a document entitled, "Exposure to High Frequency Electromagnetic Fields, Biological Effects and Health Consequences (100 kHz-300 GHz)," makes the following statement:

> "***Results of epidemiological studies to date give no consistent or convincing evidence of a causal relation between RF exposure and any adverse health effect. On the other hand, these studies have too many deficiencies to rule out an association.***"

Let us briefly analyze some of the key words used in the above ICNIRP statement, which by the way does not rule out an association between RF exposure and adverse health effects.

A. Epidemiological Studies

Epidemiological studies are important in evaluating adverse effects, but human case studies, animal studies, and in-vitro studies are also crucial in forming a complete picture of the possible health effects caused from exposure to RF radiation. Each type of study has its limitations, but *reliance on epidemiological studies is inappropriate* given the range of possible health effects and the potential ramifications if no action is taken in response to the exponential increase of wireless devices in our society and the commensurate RF exposures. Epidemiological studies are low sensitivity in nature, generally only look for the adverse health effect of cancer, and can take decades of study to account for latency periods for different types of cancers. In addition, epidemiological studies, because of their data collection over a period of years, are subject to such issues as recollection errors, that is, dependent on how often a person may have remembered using a cellular phone some years ago and whether that person may also have used a cordless phone that might not be accounted for in the results of the study.

B. Consistent and Convincing Evidence

Use of the terms consistent and convincing evidence by organizations such as the ICNIRP need to be treated with a fair amount of skepticism. Too often, biased individuals and organizations use such words in the formulation of excuses to not properly evaluate all evidence presented before them, excluding evidence that does not fully comport with established norms and beliefs. Consistent and convincing are among words that may be called the C-words. Clear, credible and conclusive are three other words commonly used by those rejecting the premise that RF radiation can cause adverse health effects. However, the greater point here is that when organizations such as the ICNIRP reject evidence that weak RF radiation fields may cause adverse health effects, they do so at the peril of also rejecting the sound scientific principle of falsification. Using Wikipedia as a basic information source at http://en.wikipedia.org/wiki/Scientific_method, the scientific method involves a process of investigating phenomenon and acquiring knowledge through a reasoned approach:

> "The scientific method is the process by which science is carried out. Because science builds on previous knowledge, it consistently improves our understanding of the world. The scientific method also improves itself in the same way, meaning that it gradually becomes more effective at generating new knowledge. For example, the concept of ***falsification*** (first proposed in 1934) reduces confirmation bias by formalizing the attempt to *disprove* hypotheses rather than prove them."

Although opponents of more stringent RF exposure standards will selectively cite elements of the scientific method such as replication of results and peer review of results published in what they deem as reputable journals, the equally valid principle of falsification or falsifiability is rarely if ever mentioned by those same individuals. Proponents of maintaining existing RF exposure guidelines set themselves up for a huge fall by insisting that adverse biological effects are only possible or plausible through thermally induced mechanisms. The concept of falsification is typically described through an illustration that involves a hypothesis that "All swans are white." Based upon observational data, it is possible to disprove this hypothesis by finding a single black swan, i.e., deductive logic admits the conclusion that the statement that all swans are white is false. Individuals who systematically review all available literature on the subject of RF exposure effects and compile documents such as the *BioInitiative Report 2012* are following an acceptable scientific approach. Authors of the *BioInitiative Report*, for example, are basically scientists

reviewing all available literature looking for “black swans,” and since it would only take one credible “black swan” to put into serious question the entire RF exposure guidelines framework, it would appear that those invested in maintaining the current exposure guidelines have a lot to lose by admitting any evidence that “black swans” exist.

Furthermore, it is inappropriate to accuse scientists who engage in the scientific process of falsification as “cherry picking.” On the contrary, those who suppress available scientific literature which identifies adverse health effects which may be caused by exposure to RF radiation emissions are those who are engaging in the cherry picking.

So in the context of RF emissions, do “black swans” exist? Certainly the authors of the *BioInitiative Report* would appear to believe so. Hundreds if not thousands of studies have shown positive results related to exposure from relatively weak RF fields.

Therefore, with the type and amount of evidence available in the published literature, it is quite possible for one to objectively conclude that the hypothesis (or universal statement) that adverse health effects can only be caused through a thermal mechanism has been ***falsified***. Consequently, and in summary, any person or organization continuing to make claims that consistent or convincing evidence does not exist for RF emissions causing adverse health effects should be treated with skepticism and questioned as to possible bias.

C. Adverse Health Effects

There is also a possible parsing of words in claims made by such organizations as the ICNIRP when they claim that ***adverse*** health effects have not been proven. Possibly they are surreptitiously admitting that weak RF fields cause “health effects” but not necessarily “adverse health effects.” In fact, the IARC and ANSES quotations referenced above mentioned “consistently observed RF dependent changes” and “limited levels of evidence [of] different biological effects in humans or animals.” Thus, one could surmise that conclusions are being made that observed biological effects caused by weak RF fields are not necessarily “adverse.” Of course, with the French press release, effects were noted that related to sleep, male fertility or cognitive performance. These would appear to be “adverse effects.” Hopefully, individuals who may be biased due to their desire to promote the profitable use of wireless technologies in our society would not consider such effects as benign.

Although there are those scientists and other individuals who promote more stringent RF exposure standards based upon documented adverse biological effects (which may not receive universal

acknowledgment), there are also those who merely have a different philosophy on how governments should protect public health and safety. For instance, as documented in an article [2] detailing a review of the rationale for the Russian RF exposure standards, it would appear to be acknowledged that Russian scientists have in fact observed a number of biological changes in animal studies due to relatively weak RF exposure over the years. "While the USSR and Russian standards were based on many areas of research, the immunology studies were viewed by the standards committees as providing the most consistent results and so were important for setting exposure limits." In attempting to briefly summarize the article, it will be stated that the Russian standards appear to be primarily based upon a number of experiments with animals such as rabbits, rats, guinea pigs, and mice where sub-thermal RF radiation exposures under controlled conditions prompted a number of biological responses.

[2] Selected quotations are provided from "Scientific Basis for the Soviet and Russian Radiofrequency Standards for the General Public," Repacholi, et. al., 2012, *Bioelectromagnetics*, 33: 623–633; refer to link at: http://onlinelibrary.wiley.com/doi/10.1002/bem.21742/abstract.

Regarding public health standards, "conclusions [were] as follows: chronic daily exposure to 100–500 μW/cm^2 can induce persistent pathological reactions (based on the immunology studies…), the most striking effect being offspring death after injection of foreign serum; [at approximately] 50 μW/cm^2 is the threshold exposure for the unfavorable biological effects found in the immunology studies but these effects were not pathological since the organism could compensate for the exposure, and continual compensation could lead to long-term adverse effects and thus should be protected against; and chronic exposure to ≤10–20 μW/cm^2 does not induce any noticeable biological changes in small laboratory animals."

Regarding mobile phone standards, "Because mobile phones have become an essential part of most people's lives, the RNCNIRP decided that they needed a special standard, especially since their use involves daily, repeated, and potentially life-long RF exposure to the brain, a critical organ." As an example, "When rats and mice of different ages were exposed to 970 MHz fields as low as 15 μW/cm^2 for up to 120 min there was a tendency toward a decrease in exploratory behavior, a suppression of the righting reflex, and a slowdown in adaption to experimental conditions. In addition, a fourfold decrease in noradrenaline levels was observed in exposed animals compared to the control group. … When determining the limit values for mobile telecommunications technology, the RNCNIRP decided to leave the limit value of 10 μW/cm^2 for the general public unchanged, as it was set in 1984 and this value was well justified by previous research so there was

no need for change. Thus, base stations should not expose the public to more than 10 μW/cm^2." For mobile phone users, a limit value of 100 μW/cm^2 was recommended. This limit provided a safety factor of 5 as compared to "earlier studies indicating that exposure to 500 μW/cm^2 produced immune system changes considered pathogenic to the organism." [Russian Standard, 2003].

"The general approach to public health protection and setting exposure limits by previous Soviet and current Russian committees is that people should not have to compensate for any effects produced by RF exposure, even though they are not shown to be adverse to health (pathological). In other words, these committees assume there could be long-term health consequences if people have to compensate for RF exposures that produce biological but not pathological effects. Exposure limits are then set that do not cause any possible biological consequence among the population (regardless of age or gender) that could be detected by modern methods during the RF exposure period or long after it has finished. Their approach to protection is that limits of RF exposure should not cause even a temporary initiation of the protective or adaptive compensatory mechanisms over the near or long term. Thus, the final exposure limits are set as a fraction of the minimum RF exposure that is capable of provoking some adaptation-compensatory reactions in people."

"Children are not small adults since they are developing organisms with special sensitivities and might be expected to be more sensitive to EMF than adults [Grigoriev, 2005; Kheifets et al., 2005]. Thus, results of studies conducted on adults might not be validly extrapolated to children; therefore, the RNCNIRP considered that children need special consideration when developing exposure limits. According to the RNCNIRP, the following health hazards are likely to be faced in the near future by children who use mobile phones: disruption of memory, decline in attention, diminished learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to stress, and increased epileptic readiness. For these reasons, special recommendations on child safety from mobile phones have been incorporated into the current Russian mobile phone standard [Russian Standard, 2003]."

"The various USSR and Russian standards committees considered that chronic exposure to nonthermal levels of RF fields was potentially hazardous to human health. Further, the key philosophy used to set limit values in the Russian standards was that RF exposure should not produce any effect that had to be compensated for by people because it was believed that this would lead to pathologic effects over the long term [Grigoriev et al., 2003b,c]."

So to summarize with regard to Russian exposure guidelines, they are developed with the recognition that non-thermal effects do occur and that these effects have been documented. It is not stated with certainty that all observed effects are pathological and/or irreversible, but in any case, it is concluded that such effects influence the physical and mental well being of affected individuals and therefore constitute a health hazard. The Russian guidelines, therefore, are science-based but include an aspect of the precautionary approach in that the guidelines are intended to prevent pathological effects that are considered plausible and possibly even likely if exposure at elevated levels were allowed to occur on a long-term basis. ***It is important to note that the Russian exposure guidelines are approximately 100 times more restrictive than those used in the United States***.

The established scientific community, including the ICNIRP should be more open about acknowledging that biological effects do result from exposure to weak RF emissions. Once this admission occurs, a more intelligent discussion can proceed regarding which biological effects should be considered "adverse" and which effects are benign, reversible, or non-pathological.

F. Austrian AUVA Insurance Company Report, 2009, Non-Thermal Effects Confirmed

Despite denials of non-thermal biological effects from organizations such as the ICNIRP, the Austrian Social Insurance for Occupational Risks (AUVA) commissioned the Vienna Medical University to carry out its own research project, focused on the effects of cell phone radiation on the brain, immune system, and proteins. The AUVA report issued in 2009 was entitled, "Investigation of Nonthermal Effects of Electromagnetic Radiation in the Cell Phone Frequency Range (ATHEM)." The title of the report itself (by using the word non-thermal) runs in direct opposition to the representatives of the "thermal paradigm" which includes organizations such as the ICNIRP that only recognize biological effects caused by the heating of tissue.

In July 2009 diagnose-funk.org released an *English* version of an AUVA Report Summary. Below are noteworthy quotes from the AUVA report that confirm the existence of non-thermal biological effects:

- "The research project ATHEM, therefore, has been aimed at studying the burning issue of potential interactions between RF/EMF and biology. (p. 7) (...) The significance of the experimental investigations also lies in the fact that the demonstrated effects, which do not necessarily have disease relevance (e.g. EEG changes), should not even have occurred according to the strictly thermal interaction mechanism that would have been covered by current exposure guidelines." (p. 8)

- "Beyond that, the significance of the results also lies in the fact that the effects should not even have occurred when assuming exclusively thermal effects, which current exposure guidelines are based on. ***Thus, these effects are further evidence for the existence of nonthermal effects***." (p. 168, see also p. 62) [emphasis added]

- "During and after the actual exposures, certain brain waves (the so-called EEG alpha band 8-13 Hz) changed. Some of the changes were statistically significant." (p. 62)

- "Some of the exposure effects were comparable with earlier studies and some of them were confirmed. In addition, new important effects were observed that may help clarify the effect mechanism of low-level RF radiation exposures on the central nervous system. (p. 92)

- ***Without any doubt, the results represent biological effects that cannot be caused by thermal mechanisms*** … Furthermore, since the effects occurred mostly independent of whether the respective side of the head was exposed or not, … ***a purely thermal effect mechanism may be excluded***." (p. 93) [emphasis added]

- "Two of the significantly changed protein levels occurred in the cytoskeleton proteins…, suggesting the cell phone radiation may have a great impact on important intracellular processes." (p. 118)

- "For the first time, it was shown that cell phone radiation exposure causes a notable change in protein synthesis profiles." (p. 168)

- "Various neurodegenerative disorders are triggered, among other things, because nerve cells show a relatively high rate of protein synthesis, which the protein transport and distribution systems of the cell cannot handle anymore. The observed cell degenerations in neurodegenerative disorders are, for the most part, attributed to this mechanism. Under these circumstances, a further increase in the rates of protein synthesis in sensitive nerve cells may seem detrimental to human health." (p. 137)

- "With the application of highly sensitive testing methods, it was possible to find clearly ***reproducible*** biological effects of cell phone radiation in cultured cells. A groundbreaking finding of this project is that cell phone radiation exposure leads to an increased formation of new proteins (e.g., ***stress proteins as a sign of cell stress***, etc.) in reactive cells." (p. 137) [emphasis added]

- "The observed pattern of a generally increased protein synthesis indicates an exposure-dependent protein inactivation. This would also

explain why in metabolically active cells naturally occurring DNA breaks—caused by free radicals—are not sufficiently repaired anymore, resulting in ***increased DNA breaks in cells that are exposed***." (p. 138) [emphasis added]

- "One of the observations showed that, among the different cells, those respond particularly strongly, which are metabolically active (editor's note: anabolic and catabolic process during metabolism). ***This cell property is especially pronounced in growing tissues, that is, in children and youth. Consequently, these population groups would be more susceptible to the described effects***." (p. 138) [emphasis added]

- "The radiation-induced effects observed, however, were not always dosage-dependent as would be expected from thermal effects. Some cells showed an even stronger response when the 5-minute exposure was followed by a 10-minute break (intermittent exposure). ***This would also support a nonthermal effect mechanism. The project results, therefore, serve as a further confirmation of the existence of so-called nonthermal effects***." (p.169) [emphasis added]

G. Most Independent Studies Show Results, Industry Funded Studies Do Not

Regarding studies showing biological effects, there is evidence that industry funded studies suffer from systematic bias towards ***not*** finding evidence of biological effects from research related to RF exposure. Based upon an article [3] dealing with the "Source of Funding and Results of Studies of Health Effects of Mobile Phone Use," a conclusion was reached that "Our study indicates that the interpretation of the results from existing and future studies of the health effects of radiofrequency radiation should take sponsorship into account."

As indicated in the article/abstract, "We examined whether the source of funding of studies of the effects of low-level radiofrequency radiation is associated with the results of studies. We conducted a systematic review of studies of controlled exposure to radiofrequency radiation with health-related outcomes (electroencephalogram, cognitive or cardiovascular function, hormone levels, symptoms, and subjective well-being)."

Based upon a systematic review of experimental studies, "Most (68%) of the studies assessed here reported biologic effects," while only 33% of studies funded by telecommunications industry showed at least one result suggesting a biological effect from RF exposure. [emphasis added]

The article attempted to provide possible explanations for the "association between source of funding and results … in the context of clinical research sponsored by the pharmaceutical industry (Baker et al. 2003; Bekelman et al. 2003; Lexchin et al. 2003). The association could reflect the selective

publication of studies that produced results that fitted the sponsor's agenda. Sponsors might influence the design of the study, the nature of the exposure, and the type of outcomes assessed. In multivariate logistic regression analysis, the only factor that strongly predicted the reporting of statistically significant effects was whether or not the study was funded exclusively by industry. We stress that our ability to control for potential confounding factors may have been hampered by the incomplete reporting of relevant study characteristics."

[3] "Source of Funding and Results of Studies of Health Effects of Mobile Phone Use: Systematic Review of Experimental Studies," Huss, et.al., *Environmental Health Perspectives*, 2007 January; 115(1): 1–4; refer to link at: http://dx.doi.org/10.1289%2Fehp.9149.

H. Business Bias as Usual: The Case for Electromagnetic Pollution

As stated in a document [4] prepared by Angelo Gino Levis, Valerio Gennaro, and Spiridione Garbisa, the term "business bias" in occupational and environmental epidemiology can be understood as "an intentional study bias, specifically set up to prioritize both economic and career-related ambitions over scientific research, whose legitimate goal should be the minimization of avoidable health damage."

Further quoting the above reference as explained in [4], "Discussion on the need to minimize exposure to electromagnetic fields (EMF) (frequency range: 0– 300 GHz) has for over half a century been split between two irreconcilable positions. On the one hand, a [so-called] 'conservative' stance rooted in the definition of exposure limits fixed since the mid-1950s on the assumption that the only effects of EMF dangerous to human health are the acute effects resulting from the passage of electric current or overheating (stimulation of muscles and peripheral nerves, shocks, burns, heating of surface tissues). … This position was agreed upon at the end of the 1990s by a group of scientists which was self-constituted under the International Commission for Non-Ionizing Radiation Protection (ICNIRP)."

"On the other hand, a large part of the scientific community – especially where there is no constraint from funding by manufacturers or managers/ operators of the technologies concerned – maintains a 'cautionary' position based on application of the Precautionary Principle and the necessity to minimize EMF exposures. This position is justified by both epidemiological and experimental data. The former data – documented after exposure of human subjects to EMF so weak as to be able to exclude any significant heating – show immediate and long-term health effects including tumors and cancers, while the latter data reveal biological effects on in vitro systems, animals and human volunteers, indicating molecular, cellular and functional mechanisms supporting a biological plausibility," as summarized below:

Mechanisms of Biological Action Supporting the Plausibility of Non-thermal Biological Effects Caused by RF/EMF

1) "Alteration of the synthesis of the hormone melatonin, involved in the deactivation of peroxide radicals, which produce DNA damage triggering carcinogenesis;
2) Stimulation of Fenton's reaction, with consequent increase in damage due to free radicals on biological macromolecules;
3) Modification of the permeability of the cell membrane and consequent alteration of the flow of biologically important ions, in particular calcium;
4) Modification of the brain's electrical activity and of the permeability of the hemato-encephalic membrane, with consequent damage to the cerebral neurons and alteration of the functioning of the cerebral neuroreceptors and neurotransmitters;
5) Alteration of the functioning of the immune system;
6) Inhibition of apoptosis (programmed cell death);
7) Expression of heat shock proteins;
8) Genetic and epigenetic effects;
9) Synergistic interactions with other carcinogens (ionizing radiation, polycyclic aromatic hydrocarbons, benzene derivatives)."

"[M]ajor national and international agencies and commissions are compromised by conflicts of interests and, as a result, make reference only to studies with negative results, that is, that are reassuring, so confirming the complete inability of mobile telephony radiation to induce head tumors, disregarding, dismissing or even manipulating the results of Hardell's work and even those – despite their indication of increased cancer risk – reported in some of the same Interphone studies."

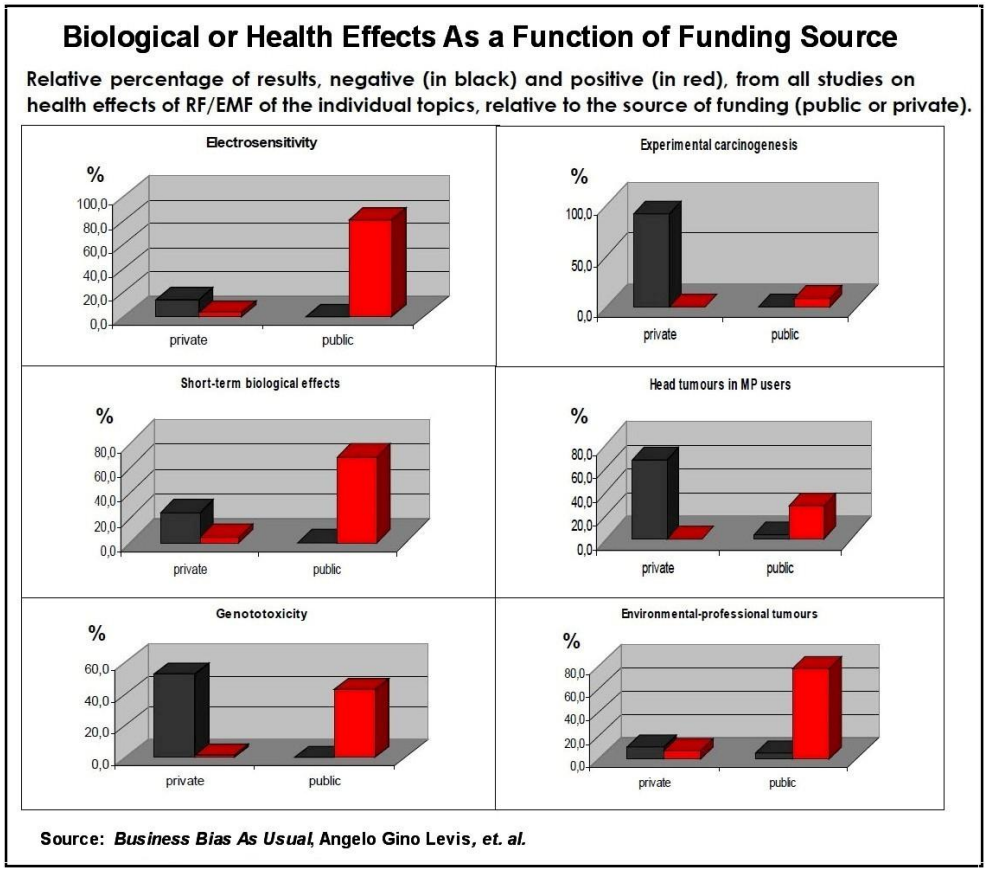
"A critical review of studies on the biological and health effects of RF/ EMF found that, out of 1,056 articles published in peer-reviewed journals, 44 percent reported negative results (no effect), with 93 percent being funded either by private bodies or by non-specified sources. Instead, 56 percent of the articles reviewed reported some kind of biological effect or harm to health, with 95 percent funded by public bodies (Levis et al. 2012b)." Refer to the figure below (or next page).

The book referenced by [4] appropriately quotes portions of a resolution and explanatory memorandum adopted by the Committee on the Environment, Agriculture and Local and Regional Affairs of the European Parliament (EP):

- "With regard to the frequently inconclusive if not contradictory findings of scientific research and studies on the possible risks of products, medicines or, in this case, electromagnetic fields, a number of comparative studies do seem to suggest a fairly strong correlation

between the origin of their funding – private or public – and the findings of risk assessments, a manifestly ***unacceptable*** situation pointing to ***conflicts of interest*** which undermine the integrity, the genuine independence and the objectivity of scientific research." [emphasis added]

- "After analysing the scientific studies available to date, and also following the hearings for expert opinions organised in the context of the Committee on the Environment, Agriculture and Local and Regional Affairs, ***there is sufficient evidence of potentially harmful effects of electromagnetic fields on fauna, flora and human health to react and to guard against potentially serious environmental and health hazards***." [emphasis added]



[4] As initially quoted, the source document was an unpublished study prepared by Levis, Gennaro, and Garbisa entitled, "Business Bias As Usual: The Case of Electromagnetic Pollution." It was later determined in sourcing of references that the essence of the originally unpublished study has been published as Chapter 11 in a book titled, Social Costs Today: Institutional Analyses of the Present Crises, edited by Ramazzotti, Frigato, and Elsner, Published by Routledge, 2012; refer to link at: http://www.routledge.com/books/details/9780415508469/.

I. Some Scientists Summarily Dismiss Low Level Effects as Contentious, Unproven Speculations: Indication of Bias

In an article [5] in the *Health Physics* journal in 2007 regarding thermal mechanisms of interactions of RF energy with biological systems, a number of statements are made that essentially exclude non-thermal exposure mechanisms from consideration in establishing exposure guidelines. ***In addition, a discussion of utilizing the concept of a precautionary approach is completely avoided by omission***. Quoting a few relevant portions of the article:

> "International Commission on Non-Ionizing Radiation Protection (ICNIRP): 'These guidelines are based on short-term, immediate health effects such as stimulation of peripheral nerves and muscles, shocks and burns caused by touching conducting objects, and elevated tissue temperatures resulting from absorption of energy during exposure to EMF' (ICNIRP 1998)."
>
> "In this paper, we consider the role of a mechanistic understanding of thermal hazards in setting exposure guidelines. … We do not consider the ***contentious*** issue of hazards from low-level exposures to RF energy. No such hazards have been ***proven***, and for that reason none have played any direct role in the IEEE and ICNIRP exposure guidelines. … Research on the effects of chronic exposure and ***speculations*** on the biological significance of low-level interactions have not changed the scientific basis of the adverse effect level." [emphasis added]
>
> "Injuries or illness from ***chronic*** exposure to RF energy at nonthermal levels, which is the subject of great public discussion, remain ***unproven***." [emphasis added]

The above quotations are provided to highlight the somewhat arrogant treatment of the "contentious" issue of chronic exposure to non-thermal RF exposure hazards. Such hazards are summarily dismissed as "unproven," despite consistently observed biological effects that occur at levels insufficient to cause heating of tissue. This attitude is attributed to a ***scientific bias*** to exclude evidence that does not comport with established beliefs.

[5] "Thermal Mechanisms of Interaction of Radiofrequency Energy with Biological Systems with Relevance to Exposure Guidelines," Foster and Glaser, *Health Physics*, 92 (2007) 609-620; refer to link at: http://www.ncbi.nlm.nih.gov/pubmed/17495663.

J. Irrational Strategy to "Cancel" a Positive Study with a "Negative" Study

According to another article [6] published in 2009, "When scientists maintain their beliefs in the face of contrary data, two diametrically opposed situations may result. On the one hand, data are seen as either right or wrong and there is no discussion to resolve disparities. On the other hand, and as Francis Crick has pointed out, scientists who hold theoretically opposed positions may engage in fruitful debate to enhance understanding of underlying principles and advance science in general. While the latter certainly is preferable, there are external factors involving economics and politics that keep this from happening. It is time to acknowledge this and embark on the path of fruitful discussion."

The article further suggested that studies which find biological effects attributable to non-thermal effects are increasingly subjected to a "weight of evidence" evaluation. In such evaluations, it is pointed out that "the distinction between weight of evidence and strength of evidence often is lacking or not defined, and differences in methodologies between investigators are not considered. Consequently, weight of evidence generally amounts to what Krimsky refers to as a 'seat-of-the-pants qualitative assessment.' … "To some investigators, weight of evidence does indeed refer to the balance (or imbalance) between the number of studies producing apparently opposing results, without regard to critical experimental variables." [emphasis added]

Thus to some, based upon the above viewpoint, the evaluation of evidence amounts to a strategy whereby one study showing non-thermal biological effects is simply canceled by any similar study showing no effect without a critical review of the experimental procedure and the investigator's interpretations and conclusions. Such a strategy, to the extent it exists, is not productive to the intelligent debate necessary for the full scientific community to arrive at explanations to describe the underlying mechanisms for consistently observed biological effects occurring as a result of non-thermal exposures to RF radiation.

[6] "Electromagnetic Fields and DNA Damage," Phillips, et.al., Pathophysiology, 16 (2009) 79–88; refer to link at: http://www.ncbi.nlm.nih.gov/pubmed/19264461.

K. Evidence of Wi-Fi Causing DNA Damage

SkyVision Solutions acknowledges that selected studies are not sufficient to "prove" evidence of harm; however, there is value in actually reading some of the studies showing evidence of harm. This is necessary in the face of all the supposed experts adhering to the "thermal paradigm" who claim that no such credible evidence exists. If an educated and thoughtful person objectively reviews available evidence, SkyVision Solutions is confident that the logical

conclusion will be to proceed with caution with regard to mandatory exposure of an entire population group to RF radiation emissions.

One published article [7] is entitled, "Use of Laptop Computers Connected to Internet through Wi-Fi Decreases Human Sperm Motility and Increases Sperm DNA Fragmentation." In the study, researchers took sperm samples from 15 men. Some of the samples were exposed to RF radiation from Wi-Fi for four hours, while the other samples were not. At the end of the fours hours, the results were: "…laptop exposure induced a significant decrease in sperm progressive motility with a concomitant increase in non-motile sperm compared with the unexposed controls. … Important, a significant increase in sperm DNA fragmentation was found in the fraction incubated under the computer compared with the control group." The conclusion of the study was "We have demonstrated that exposure to laptops decrease progressive motility and induce DNA fragmentation in human spermatozoa in vitro by a non-thermal effect [emphasis added]."

An important aspect to this study was that the RF energy levels for the exposed samples were generally in the range of 0.5 to 1.0 µWatt/cm^2, on the order of 1,000 times less than the applicable FCC exposure guideline for thermal effects.

Yes, one cannot overstate the results of one study. In this case, the researchers were careful to make the following statement: "In a real-life setting, sperm may not necessarily be affected the same way, … and recommended carrying out further research to validate these results." From a risk perspective, however, keep in mind that anything which damages human sperm on a large scale basis potentially damages the entire human race.

[7] "Use of Laptop Computers Connected to Internet through Wi-Fi Decreases Human Sperm Motility and Increases Sperm DNA Fragmentation," by Conrado Avendaño, et.al., American Society for Reproductive Medicine, *Fertility and Sterility*, volume 97, Number 1, January 2012, pp 39-45; refer to link at: http://www.fertstert.org/article/S0015-0282(11)02678-1/abstract.

[Note that some sources including the AAEM refer to the above results being reported in 2010. It is the understanding of SkyVision Solutions that this was a preliminary report; the final peer reviewed article was published in the 2012 issue of *Fertility and Sterility* as indicated above.]

L. Wi-Fi Alters Electrical Brain Activity

Another article [8] is entitled, "Effects of Wi-Fi signals on the P300 Component of Event-related Potentials during an Auditory Hayling Task." This study showed that RF radiation from Wi-Fi altered electrical brain activity and decreased attention in young adults exposed to electromagnetic fields from Wi-Fi during mental tasks. Study participants were given memory tests to perform, both with and without RF exposure. The tests were performed blind, meaning the participants did not know when the Wi-Fi was on and when it was off. Participants in both studies were 1.5 meters from a Wi-Fi access point, which operated at a frequency of 2.45 GHz. These results demonstrated that Wi-Fi can have a negative effect on attention and mental activity. They also suggest that

Wi-Fi can potentially affect brain development in children and young people, dependent upon electrical brain activity. In the study, conducted by a team led by Charalabos Papageorgiou, exposure to Wi-Fi signals were shown to decrease a measure of attention in young men using their working memory. When accomplishing a mental task, a person uses his working memory to keep information readily available to his brain. Working memory is used in activities such as problem solving, decision making, planning, reasoning and monitoring. The researchers used a version of the Hayling Sentence Completion test to stimulate the working memory of young men and women in their early 20s who were recruited to participate in the study. While performing the task, researchers measured electrical activity on the surface of the participants' brains. At a set point after hearing the sentence a peak voltage, called P300, was recorded on the scalp. P300 amplitude is thought to be an index of mental activity and attention. The study showed that the amplitude of the P300 peaks were greatly decreased in the young men and slightly increased in the young women when a Wi-Fi access point, positioned 1.5 meters away, was switched on. The study also showed, in the presence of a Wi-Fi signal, the men's P300s were significantly lower than the women's.

Below is a figure created from the results of the study showing alterations in EEG-related parameters with and without a Wi-Fi signal.

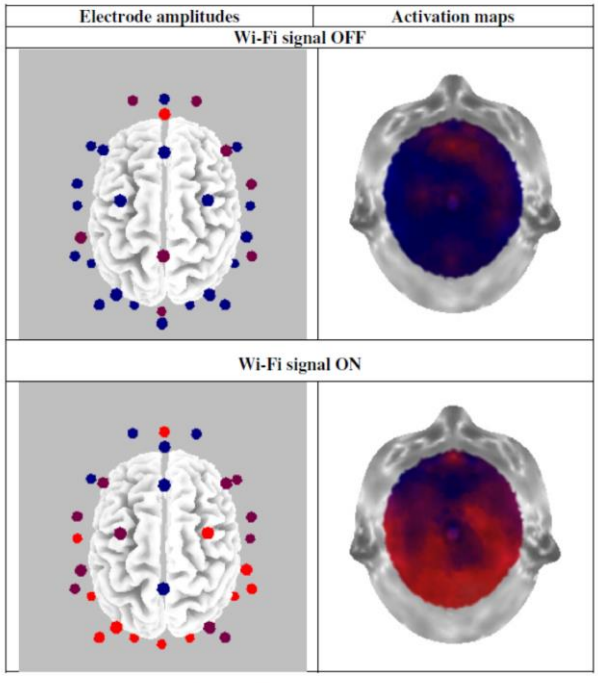


Fig. 4. Comparisons of the electrode amplitudes (left) and activation maps (right) of the P300 component between male and female subjects at the presence (top) and absence (bottom) of the Wi-Fi signal at Hayling B condition. Red color denotes statistically significant differences between the two genders.

Source: "Effects of Wi-Fi signals on the P300 Component of Event-related Potentials during an Auditory Hayling Task," Charalabos Papageorgiou, et.al., *Journal of Integrative Neuroscience*, June 2011.

Some of the final statements in the journal article are as follows:

> "In particular, central nervous system effects of EMFs have been considered to be secondary to damage to the blood–brain barrier (BBB) permeability. It is reasonable to consider the existence of gender-related blood barrier differences, a fact which would explain the fundamental differences between males and females in the intrinsic cognitive processes and in the way they are affected by different types of electromagnetic radiation. Other studies indicate that EMF exposure affects melatonin release. Specifically, a reduced excretion of the urinary metabolite of melatonin among persons using a mobile phone for more than 25 mins per day has been demonstrated. … To the best of our knowledge, this is the first attempt to investigate the immediate effects of Wi-Fi signals upon brain operation, specifically on the P300 ERP [event-related potentials] component. Our investigation revealed that P300 amplitude values are decreased for males and increased for females during exposure while performing a Hayling Sentence Completion task. These gender-related differences provide further support to previous studies of our team conducted under different exposure conditions and different auditory tests. As far as the different Hayling tasks are concerned, results show significantly decreased amplitude values for the response inhibition condition in a large area of the brain. … *In conclusion, the present findings suggest that Wi-Fi exposure may exert gender-related alterations on neural activity associated with the amount of attentional resources engaged during a linguistic test adjusted to induce WM* [working memory][emphasis added]."

Based upon the results of this article, RF radiation emissions from Wi-Fi signals affect human physiology and, in this case, the cognitive processes of test subjects. Consistent with the rationale presented earlier from Russian scientists, it cannot be claimed with certainty that all observed effects are pathological and/or irreversible, but in any case, it should and can be concluded that such effects influence the physical and mental well being of affected individuals and therefore constitute a potential health hazard.

[8] "Effects of Wi-Fi signals on the P300 Component of Event-related Potentials during an Auditory Hayling Task," by Charalabos Papageorgiou, et.al., *Journal of Integrative Neuroscience*, June 2011, pp 189-202; refer to link at: http://www.ncbi.nlm.nih.gov/pubmed/21714138.

M. Evidence of Electromagnetic Hypersensitivity (EHS)

Although the scientific establishments of so-called Western countries do not generally recognize Electromagnetic Hypersensitivity (EHS), SkyVision Solutions has found certain studies noteworthy and one is discussed here. An article [9] published in 2011 is entitled, "Electromagnetic Hypersensitivity: Evidence for a Novel Neurological Syndrome." It is acknowledged that the protocol for the study reviewed by this article utilizes "environmental-strength electromagnetic fields" at

frequencies well below what would be encountered with Wi-Fi. However, at this point, it is the EHS syndrome itself that organizations such as the ICNIRP do not recognize, no matter what the frequency of EMF-related emissions.

Selected quotations from the referenced article are now provided:

- "Man-made electromagnetic fields (EMFs) such as those produced by cell phones, powerlines, or computers are ubiquitous in the general and workplace environments. About 3%–5% of the population subjectively associates acute or subacute exposure to EMFs with departures from normal function or feeling (EMF hypersensitivity). The prevalence of self-reported EMF hypersensitivity has usually been attributed to somatization disorders."

- "A possible non-psychological basis for EMF hypersensitivity was provided by the discovery of the ability of human beings to detect weak EMFs, as evidenced by the occurrence of field-onset and field-offset brain potentials, and the induction of steady-state changes in brain electrical activity that persisted during the presence of the field. The underlying mechanism of field sensory transduction appears to be an electric force-sensitive ion channel. Animal studies suggest that the electroreceptor cells and/or afferent processing cells are located in the brain stem."

- "We sought direct evidence that acute exposure to environmental-strength electromagnetic fields (EMFs) could induce somatic reactions (EMF hypersensitivity)."

- "Methods: The subject, [was] a female physician self-diagnosed with EMF hypersensitivity." … "A total of 300 independent trials involving carrier frequencies of 60 Hz to 500 kHz were used; the controls consisted of 150 sham trials."

- "Results: In a double-blinded EMF provocation procedure specifically designed to minimize unintentional sensory cues, the subject developed temporal pain, headache, muscle twitching, and skipped heartbeats within 100 s after initiation of EMF exposure ($p < .05$). The symptoms were caused primarily by field transitions (off–on, on–off) rather than the presence of the field, as assessed by comparing the frequency and severity of the effects of pulsed and continuous fields in relation to sham exposure. The subject had no conscious perception of the field as judged by her inability to report its presence more often than in the sham control."

- "The subject developed symptoms in association with the presentation of a pulsed electric field significantly ($p < .05$) more often than could reasonably be explained on the basis of chance."

- Discussion: The subject demonstrated statistically reliable somatic reactions in response to exposure to subliminal EMFs under conditions that reasonably excluded a causative role for psychological processes.

- Conclusion: *EMF hypersensitivity can occur as a bona fide environmentally inducible neurological syndrome* [emphasis added]."

[9] "Electromagnetic Hypersensitivity: Evidence for a Novel Neurological Syndrome." By McCarty, DE, Marino, A., et.al, *International Journal of Neuroscience*, December 2011, volume 121, pp 670-676; refer to link at: http://www.ncbi.nlm.nih.gov/pubmed/21793784.

[For PDF document viewers, click on the following hyperlink for an Interview with Andrew Marino Ph.D., one of the authors of the above article.]

N. A Review of Electromagnetic Hypersensitivity (EHS) Literature

One article [10] published in 2012 reviewed the controversy surrounding the topic of EHS and is aptly called, "Electromagnetic Hypersensitivity: Fact or Fiction?" Specifically, the article presents a "review of the emerging literature related to the perplexing EHS condition … along with a case history detailing with the development of EHS and subsequent recovery in an otherwise healthy individual."

EHS can generally be described as, "… a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs)…" As expressed in the article, Electromagnetic Radiation (EMR) "appears to act as a trigger for perceived physiological disturbances in the body. The range of frequencies associated with EHS is usually within the non-ionizing range of the electromagnetic spectrum." Symptoms can include headache, thought processing difficulties, memory impairment, heart palpitations, sleep disorder, general malaise, blurred vision, weakness, dizziness, chest discomfort, muscle pain, tinnitus, fatigue, nausea, night sweats, restless legs, and paresthesias.

The article discusses the controversy surrounding EHS and makes the following key conclusions:

"Over the last 50 years, there has been an anthropogenic electromagnetic revolution with the widespread release of electronic equipment, wireless systems, electrical machines as well as pervasive high voltage power lines and telecommunication emitters; in the next 50 years we will begin to witness the consequences of these developments. We have an ethical responsibility to define the impact of such technology on the human organism and to develop methodologies to investigate and manage adverse sequelae."

"When exposed to certain frequencies of EMR, patients with EHS experience non-specific signs and symptoms affecting multiple body systems; many are rendered disabled and unable to function effectively in society."

"Further research is required to fully understand the detailed pathophysiology of EHS and to enhance current therapies to ameliorate the suffering experienced by afflicted individuals."

*"**Recent evidence in the scientific literature suggests that various objective physiological alterations are apparent in some EHS persons claiming to suffer after exposure to certain frequencies of EMR (McCarty et al., 2011; Havas et al., 2010). As a result, many scientists now recognize that hypersensitivity to EMR can be a debilitating medical condition that is affecting increasing numbers of people throughout the world.** While EHS patients can initiate steps to reduce exposure to EMR once they recognize the importance of doing so, more clinicians familiar with EHS and the SRI [sensitivity related illness] mechanism of ill-health are needed to diagnose, assist and treat the burgeoning number of suffering individuals who are at a total loss to explain their various symptoms. In the end, regardless of whether one chooses to believe that EHS is fact or fiction, every ethical health provider has an obligation to sincerely listen to his/ her patients, including those with EHS, and to do everything possible to ameliorate their suffering."* [emphasis added]

[10] "Electromagnetic Hypersensitivity: Fact or Fiction?", Genuis SJ, Lipp CT, *Science of the Total Environment*, January 2012, volume 414, pp 103-112; refer to link at: http://www.sciencedirect.com/science/article/pii/S0048969711012733.

O. Austrian Research Study to Determine Prevalence of EHS

Going beyond one selected research study on EHS and the literature review article described above, let us finally review a more broad survey-based article of interest entitled, "Sensitivity to Electricity – Temporal Changes in Austria," written by Joerg Schröttner and Norbert Leitgeb in 2008 and published online at the following link: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2562386/.

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Selected quotations from the article are provided below:

"The aim of the present survey was to get actual data and to assess potential temporal changes of the prevalence of EMF-related concerns and hypersensitivity compared to the initial study of 1994."

"To assess the prevalence of EMF-related problems, an inquiry among Austrian general practitioners has been recently performed. The results showed that there is a widespread contradiction between physician's opinion and the judgment of national and international health risk assessment bodies. An overwhelming percentage of general practitioners (96%) to at least some degree believed in the effects of environmental electromagnetic fields on health, and only 39% have never associated health symptoms with electromagnetic pollution. A similar discrepancy between physician's opinions and established scientific assessment was shown in an inquiry study including 342 interviews of physicians in Switzerland." [emphasis added]

"In 1994 Leitgeb investigated the EHS issue and first estimated the potential EHS subgroup to be less than 2% of the general population. … Electrosensitivity (the ability to perceive electricity) was assessed [based results published in 1998] by a quantitative parameter, namely the perception threshold of directly applied electric 50 Hz currents. The analysis of double-blind perception measurements at a sample of 606 persons indicated the presence of a subgroup of 2% with significantly increased sensitivity. Further investigations of electric current perception thresholds on an extended sample of the general population confirmed the initial finding of a 2% electro-sensitive subgroup with significantly increased perception threshold [based on study results from 2003 and 2007]."

"This study shows that the actual percentage of persons claiming to be electromagnetic hypersensitive amounts to 3.5%, which is almost twice compared to the potential of 2% formerly estimated by Leitgeb in 1994, based on measurements of the electric current perception. A comparison of reported EHS prevalence's of different studies faces methodological problems, because objective EHS-criteria are lacking and classifications as EHS are quite different among the studies."

The published article described above gives perspective on the prevalence of individuals in our society who may be afflicted with EHS. Although the World Health Organization and the ICNIRP may not formally recognize that EHS symptoms are caused by RF emissions, it is remarkable to note that an overwhelming majority of medical practitioners in Austria and Switzerland, based upon survey results, believe that electromagnetic fields have an effect on health. The aforementioned Austrian research study supports a viewpoint that physicians and other medical professionals are much more convinced of RF emissions affecting human health than are certain bureaucratic scientific bodies and those that promote the advancement and proliferation of wireless technology.

P. A Note on the “Precautionary Principle” and the “Precautionary Approach”

The "precautionary principle" represents the concept that when there is evidence of adverse health effects, precautionary measures should be taken, even when some cause and effect relationships are not fully understood or established. Precautionary measures can be adopted which complement Federal guidelines which do not fully address stakeholder issues and concerns, e.g., FCC exposure guidelines not addressing low level chronic exposure mechanisms.

The use of the term “precautionary principle” is common in Europe, but in the United States there has been some opposition to the word “principle” because this term has special connotations in legal language, due to the fact that a “principle of law” is a source of law. This means that it may be compulsory, so a court could annul or confirm a decision through the application of the precautionary principle. In this sense, an alternate term is usually advisable in the United States which conveys the proper inference. One such term is “precautionary approach” which is a softening of the term “precautionary principle” and whereby it represents a particular “lens” by which a prudent person may determine risk. Its application may or may not be legally binding depending on the setting. Within the context used in this document, regarding RF radiation emissions from wireless devices, the precautionary approach is used as a practical risk management tool in order to help determine appropriate public policy.

Precautionary measures should be chosen that are proportional to the seriousness of a plausible threat of harm to this or future generations.

SkyVision Solutions uses the term precautionary approach as applicable in this document. Precautionary principle only appears as quoted from other referenced documents.

Q. About the Author of this Document

The Author (generally referred to as SkyVision Solutions within this document) has earned a B.S. in Engineering Physics and an M.S. in Nuclear Engineering with a specialty in radiation protection, both degrees received from the University of Illinois at Urbana-Champaign. He was employed by a leading electric utility for over 25 years. He served in various positions, including Station Health Physicist, Senior Health Physicist, corporate Health Physics Supervisor, and corporate Senior Technical Expert for Radiobiological Effects.

The Author has received specialized training in radiation biophysics, radiological emergency response planning and preparedness, and project management. He has participated in various industry committees and activities related to the Edison Electric Institute, the Institute for Nuclear

Power Operations, the American Nuclear Insurers, and the Nuclear Energy Institute. He is a member of the Tau Beta Pi Association and is also a member of the Honor Society of Phi Kappa Phi. The Author is a plenary member of the Health Physics Society and has three times served as President of the Midwest Chapter of the Health Physics Society. He has retired from full time employment and currently operates a website under the name of SkyVision Solutions at http://skyvisionsolutions.org dedicated to raising public awareness about the benefits, costs, and risks associated with smart grid systems as well as the potential hazards related to radiofrequency (RF) radiation emissions from all wireless devices.

R. Perspective of SkyVision Solutions on EHS and Other Adverse Health Effects

Based upon the fact that humans are bioelectrical entities, it is believed to be completely plausible that individuals can be adversely affected by exposure to electromagnetic fields in ways that do not involve a thermal mechanism. SkyVision Solutions has concluded that sufficient experimental and case study evidence exists to validate the hypothesis that EHS is a valid syndrome.

It is acknowledged that there may be a tendency for EHS to be over-reported by some individuals since symptoms of EHS share those of other medical conditions such as a psychosomatic illness or chronic fatigue syndrome. However, the converse is also likely true where doctors may misdiagnose a psychosomatic illness or other illness because they are unaware of the possible relation of clinical symptoms to EMR.

On the subject of Wi-Fi in schools and based upon the discussion and evidence presented in this document, as well as other relevant information, SkyVision Solutions shares the position taken by the American Academy of Environmental Medicine (AAEM):

"*To install Wi-Fi in schools plus public spaces risks a widespread public health hazard that the medical system is not yet prepared to address. … It is better to exercise caution and substitute with a safe alternate such as a wired connection. While more research is being conducted, children must be protected. Wired technology is not only safer; it [is] more secure*."

In concluding this document on the discussion of "Low Level RF Radiation Induced Biological Health Effects," SkyVision Solutions recommends reading a reprint of a blog article which demonstrates in a step by step fashion that evidence is mounting for RF radiation being considered definitely *carcinogenic*. In addition, evidence continues to mount regarding *other* types of adverse biological effects caused by RF radiation emissions, some of which are summarized in the final section of the linked article.