June 7, 2020

From: Richard Bennett, Lakewood citizen
To: Mayor Adam Paul
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Council Member Charley Able
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Council Member David Skilling
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Council Member Karen Harrison
Council Member Dana Gutwein
City Manager Kathy Hodgson
City Attorney Timothy Cox
cc: Ken Fellman

Subject: Moving forward with small cells for Lakewood's recovery

Dear Mayor, Council Members, and Staff,

I believe the time has come for the Council to approve the small cells item, amending Article 10 of the Lakewood Municipal Zoning Code and Title 12 of the Lakewood Municipal Code, without the setback provision. This code update, required by state law, is consistent with the interests of Lakewood residents in enjoying the benefits of the next generation of wireless technology.

The item has been delayed in large part because of the Council's desire to bend over backwards to appease a small but vocal group of petitioners raising health and safety concerns. Even if such concerns were within the city's purview (which they aren't,) petitioners propose a course of action inconsistent with their stated goals and threatening to our recovery from the pandemic.

5G is the safest wireless broadband network ever built. Going forward with small cells in Lakewood will reduce the public's exposure to electromagnetic frequency (EMF) emissions and increase the number of miles of fiber optic cable in the city, the two chief objectives petitioners tout. Petitioners' failure to realize that they win by losing comes from their lack of understanding of wireless technology fundamentals.

Petitioners have failed to present credible evidence that the intended use for small cells (4G and 5G wireless data networks) is inherently hazardous or that limiting the number and placement of small cells would reduce the public's risk.

Because EMF exposure caused by 4G and 5G wireless signals does not pose a health risk, the increased exposure petitioners demand would have no health consequences. But it will increase the cost and reduce the performance of the 5G system as a whole. It will also reduce personal device battery life, inconveniencing the public and further stressing the waste disposal and recycling system.

But even if we take petitioners' health concerns at face value, limiting the number of cells and increasing their spacing would not decrease risk; in fact, it will increase the public's exposure to EMF emissions from personal devices.

The simple fact is that 99.95% of the EMF energy absorbed by humans in the course of using wireless networks comes from personal devices, the phones we hold to our ears and the laptops and tablets we place on our laps. Because the personal device has to generate a signal strong enough to reach the network at its nearest point, small cells reduce our exposure to EMF by allowing personal devices to transmit at lower power levels.

In other words, when personal devices are close to network cells, they are able to modulate their transmissions to reduce power (amplitude) to a level less than needed to reach a cell farther away. When people are sitting side by side we can whisper, but when we are 300 feet apart, we have to yell.

If one believes wireless signals are dangerous, surely it follows that limiting their power would be a desirable means to the goal of reduced EMF absorption. Wireless signal strength degrades at the 4^{th} power of the distance the signal travels from its source, so the EMF absorption reduction from small cells over large ones is exponential.

Small cell transmitters also broadcast lower levels of power than do traditional cells. A small cell across the street from my house will transmit a power level roughly comparable to a Wi-Fi access point. As I am not worried about the four Wi-Fi access points inside my house, I will certainly not be worried about having an equivalent radio outside the house.

Small cells also force carriers to install more fiber optic cable, consistent with another stated goal of petitioners. While they may insist that networks that are part fiber optics and part wireless are undesirable, they skate on thin ice if they believe the people of Lakewood are willing to abandon cell phones. Wireless networks are here to stay and the entire community of network suppliers, service providers, and users is – and always has been – committed to safety.

Investment in small cell, 5G technology is critical to the post-pandemic recovery. It's wise to encourage that investment rather than to throw roadblocks in its path.

Contents

Benefits of 5G Technology

5G enables an entirely new set of use cases and applications by providing high speed, low latency broadband service to devices in motion. The following is brief overview of trials on a small fraction of these use cases.

5G applications are enabled by three key features of the new network:

1) Peak data rates faster than 10 Gbps
2) Device connection density of greater than 1 million per km^2
3) Latency below 1 millisecond (for ultra-reliable machine-to-machine communication).

The types of applications that are being developed to use these new 5G networks aim to touch every aspect of human life—not just mobile communications. IHS Economics predicts that 5G is going to be the driving force that makes mobile technology a General-Purpose Technology (GPT) and that it will

enable $12.3 trillion of global economic output. (Reference: IEEE Communications Society white paper, A Look into the Future: The Applications Behind 5G.)

Such applications are expected to proliferate across all sectors of the economy.

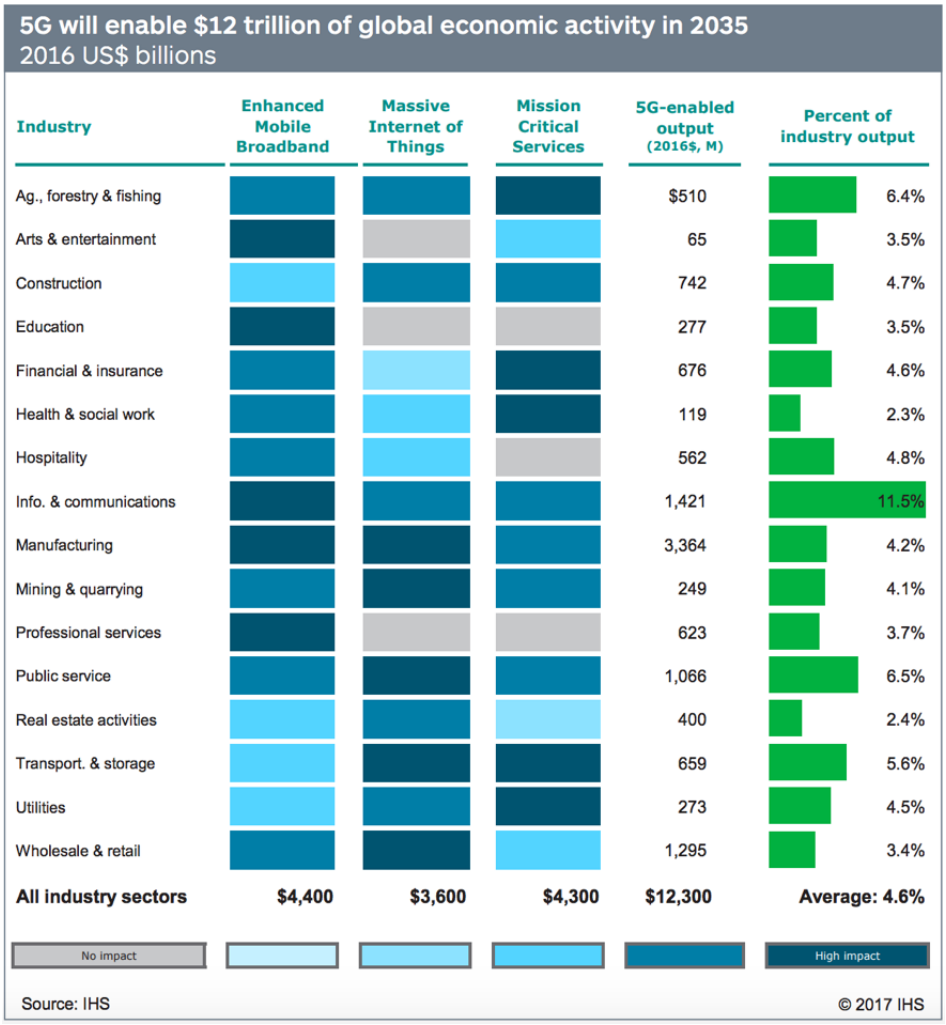

Figure 1 https://cdn.ihs.com/www/pdf/IHS-Technology-5G-Economic-Impact-Study.pdf

While 5G deployment will take several years, applications are already emerging. Here is a brief collection of key applications in entertainment, healthcare, vehicle safety, national defense, public safety, and education as reported by the press.

Fans of the Olympic Winter Games 2018 to experience world's first broad-scale 5G network

> *Worldwide TOP Partners Intel and Samsung, together with domestic sponsor KT, have partnered to complete the world's first broad-scale 5G network, available at the Olympic Winter Games in PyeongChang. Spectators will enjoy the Olympic Winter Games more vividly than ever before, as 5G is a game-changer for video, allowing viewers to enjoy high-resolution media streaming at gigabit speeds and low latency.*

The 5G experience will feature the world's first broad-scale network from KT, paired with Intel and Samsung's 5G technology, to provide a series of immersive on-site 5G experiences.

One hundred cameras are placed around the Olympic Ice Arena to capture 360-degree views of the action on the rink. They will capture video in real time and transmit it to nearby edge servers. That information will be sent over KT's Olympic 5G network to its data centre, where servers using Intel scalable processors will rapidly produce time-sliced views of the athletes in motion. It will then be transmitted over Intel's 5G Mobile Trial Platform providing gigabit speeds connectivity.

A secondary time-slicing demonstration will be available in the KT "5G.Connected." Pavilion, which will allow attendees to step onto a virtual version of the Gangneung Ice Arena and show off a few of their ice hockey moves. Multiple cameras will capture their moves in real time from various angles, sent to nearby edge servers and processed by Intel FlexRAN technology.

Multiple 5G-connected cameras have been set up along the cross-country course in Alpensia, capturing the skiers as they travel along their path. On the slopes, omni-view and multi-angle broadcasting technology is placed to provide personalised views of athletes in motion, triggered by GPS sensors.

The "Gwanghwamun KT live site" will be created to provide an Olympic atmosphere for people in Seoul unable to attend the games in PyeongChang, offering a 5G device experience zone including various 5G programmes such as "Bobsleigh Challenge" – a motion sensor game to experience bobsleigh.

In the VIP experience and spectator zones, Samsung 5G-enabled tablets will be available to view streaming HD video of the athletes from virtually any angle, as well as athlete data and statistics.

True Corporation turns ambulances into virtual ERs with 5G

Thailand's True Corporation and the Nopparat Rajathanee Hospital in Bangkok's Kannayao district are supporting the deployment of 5G technology in ambulances to make it possible for EMTs to better prepare patients for hospital care. Specifically, the goal is to facilitate better communication between on-the-ground paramedics and hospital staff, allowing for enhanced diagnosis and treatment.

"The use of 5G networks and advanced innovation technology makes it more smooth for medical communication, which empowers the New ER model — the first of its kind in Thailand," said Somboon Tosborvorn, director of Nopparat Rajathanee Hospital.

Chalermpon Chairat, chief of the emergency unit at the hospital, said that the smart ambulances have CCTV cameras capable of live-streaming all activities taking place inside the vehicle, and that staff can wear augmented reality (AR) glasses to transmit images in real time to doctors, so they can observe patients' symptoms, allowing them to develop care action plans or preparing needed medical equipment before the patient even arrives in the ER.

"We plan to use mobile CT scans and mobile X-rays including mobile ultrasound in the ambulance," Dr. Chalermpon said, adding that this will speed up the scanning process by 30 minutes.

Why 5G is a crucial technology for autonomous vehicles

Autonomous vehicles could dramatically improve safety, in a future where self-driving cars are ubiquitous. Getting to that point, however, requires extensive investments in the development of machine learning models for interpreting traffic, and infrastructure for low-latency wireless networks.

As 5G mobile networks are still in the early stages of deployment, the potential for 5G-connected driverless cars is still several years away. As carriers are investing billions into 5G networks, research into autonomous driving is accelerating to Autobahn-level speeds.

There are several approaches -- or potentially, outcomes -- that are possible with autonomous vehicles. Vehicle-to-vehicle (V2V) communication, as the name implies, connects cars to each other for sharing data about route and speed.

"There's obviously a big upside of being connected to everybody else on the road, because then the cars become aware of their surroundings," said Andras Somkuti, president of Docler Holding, a company that has investments in autonomous driving technology. "If you want to take this to the extreme, maybe traffic lights won't be required in the future. If everybody knows where everybody is. If they communicate flawlessly with zero latency, then you could dream up a world where no traffic lights are required."

Conversely, vehicle-to-everything (V2X) communication allows for wider communication possibilities, allowing for automated communication with parking meters, parking garages, and various types of 'street furniture', potentially allowing for street lights to be switched off if no drivers are on a given road, for example. Building these integrations not only requires technology to be integrated into vehicles, it also requires a substantive rethink of how public infrastructure is built -- including street furniture, traffic lights, and potentially roads themselves.

Pentagon Seeks Ramp Up in 5G Investment, What Does it Mean for Military Avionics?

The Pentagon fiscal year 2021 budget requests $449 million in research and development for the 5G next generation information communications technology program, $249 million more than provided by Congress last year.

5G "is a critical technology to the Department of Defense" and "enables high bandwidth, real-time, densely-connected networks, which represent many of the use cases central to defense command, control, and communications," Charles Clancy, vice president of intelligence programs at MITRE, wrote in an email to Avionics International.

Clancy is the author of a recent MITRE paper, 5G and the Front Lines of the U.S.-China Great Power Competition.

In December, Congress called on DoD to speed development of 5G telecommunications technologies and to provide quarterly updates on 5G advancement starting next month.

Eric Schmidt, the former Google CEO and current chair of the Pentagon's Defense Innovation Advisory Board, told a House Science Committee hearing last month that China has plans to overtake the U.S. in quantum computing, supercomputing, aerospace, 5G, mobile payments, new energy vehicles, high speed rail, financial technology and artificial intelligence.

On 5G, Schmidt told lawmakers that the U.S. needs a counter to China's Huawei. The Pentagon has cited potential security concerns in calling the United Kingdom's recent decision to allow Huawei to work on U.K. 5G telecommunications "problematic."

5G will likely be a key component in next generation military avionics.

The Facts About 5G for Public Safety

In addition to improving connectivity for existing LPWA and other 4G applications, 5G will enable completely new capabilities based on 5G New Radio (NR). Utilizing a different part of the wireless spectrum called mmWave, 5G NR can deliver data rates many times higher than an average cable or fiber broadband connection. mmWave and an improved core network, called 5G Core Network, also enable truly disruptive capabilities, including ultra-high reliability, very low latency and very fast handoffs, supporting new types of fixed and mobile public safety 5G IoT applications related to:

***Access to information** – According to IDC, 5G capabilities will help improve the ability of first responders to access critical information. From streaming information collected from smart city sensors to immediate access to patient data while patients are being rushed to the ER, first responders will have access to more information before they arrive on the scene and during their response.*

***Autonomous vehicles, beyond-line-of-site drones, and robots** – 5G will enable better command and control of beyond-line-of-site drones and other unmanned vehicles, allowing public safety professionals to respond faster and gain more situational awareness during emergencies.*

***Real-time video** – 5G's ability to transmit massive amounts of data in real time will help enable new in-car and body-worn camera applications that provide immediate situational awareness to command staff, other responding officers, and other units in the field. With more eyes available to monitor a rapidly evolving situation, public safety professionals will be able to provide more informed support and make better decisions during an emergency.*

***Augmented and virtual reality** – 5G-enabled applications like these will allow public safety agencies to develop realistic simulations of crisis situations for training and testing purposes.*

First Minister demo shows how 5G could transform education and manufacturing

Figure 2 Scotland's First Minister Nicola Sturgeon saw a live virtual reality (VR) demo this week of 5G technology's potential to transform teaching, learning and manufacturing.

The demo resulted from partnership working between BT, Glasgow City Council, the University of Glasgow and the Scotland 5G Centre to support Scotland's 5G strategy.

Using 5G and VR to deliver education globally

The live VR simulation saw BT and researchers from the University of Glasgow demonstrate to the First Minister the use of 5G technology as a tool in education and manufacturing.

At a meeting with BT chief executive Philip Jansen in Edinburgh (pictured), she was able to watch, in real time via VR, a teaching scenario take place in a secure 'clean' area of the James Watt Nanofabrication Centre in Glasgow.

The demo illustrated how the faster speeds, reliability and responsiveness of 5G could enable a lecturer to provide immersive content to campuses and classrooms across the world. Lecturers and students would be able to interact in real time.

It also showed how people could visualise the operations of a manufacturing site from anywhere in the world, removing the need for them to be physically present, reducing disruption and contamination risks in 'clean' facilities, cutting travel and increasing access to experts and facilities.

Reviews Showing Safety

As a veteran of the initial development of Wi-Fi, I can say with confidence that 5G is the network we would have designed in the early 1990s if we had the tools we have today. We wanted a network that could be used in retail point of sale transaction, such as the self-checkout system at Home Depot today. We also wanted to connect computers in small businesses and corporate departments to shared printers, modems, file servers and campus networks. We weren't out to connect everyone to the Internet because no one used the Internet except academics and defense contractors.

The initial Wi-Fi standard included both a radio-based transmission layer and a nominally safer infrared (IR) system. The IR system was developed by my client, Photonics Corporation in Los Gatos, California. Photonics was a spin-off of Apple Computer that targeted the K-12 education market.

The founder chose IR because even then an anti-radio movement was critical of the effects of radio-based networks on children. He feared activists would discourage parents from allowing their children to use radio networks regardless of scientific findings.

They have certainly tried to do this. In the years that followed, the public was able to choose radio networks or nominally safer IR; we resoundingly chose radio for higher performance, longer range, and greater reliability.

It is possible for radiation to damage living organisms. This comes about when the amplitude (commonly called "power") and frequency of an emission is sufficient to penetrate the organism's natural and man-made shields – skin, clothing, sunblock, and houses – at depth and power sufficient to disturb cellular function. Sunburn is an example of such damage. The body has mechanisms to repair most cellular damage, but these mechanisms have limits.

People can die from over-exposure to sunlight, but we rarely do. Our skin is evolved to shield us from sunlight's worst effects. In small doses it is beneficial to plants – enabling photosynthesis – and to animals, stimulating the production of Vitamin D, keeping us warm, and enabling us to see. But we know we have to limit our exposure in order to gain the benefits and safeguard ourselves from the hazards.

Consequently, EMF safety studies focus on drawing a line between safe and unsafe exposures. In the US, this exercise is handled by the FCC, FDA, NIOSH, and EPA.

Several national and international agencies are tasked with analyzing, making recommendations, and/or creating regulations for wireless networks and devices. Here are summaries of recent work by the most relevant agencies

Federal Communications Commission

The FCC periodically analyzes and, if necessary, adjusts regulations on EMF emissions to ensure that the networks and devices we use are safe. The most recent such review was released on December 4, 2019. Oddly, anti-5Gers claim that FCC hasn't looked a wireless safety for 20 years. In the 2019 review the FCC didn't change basic power limits, but it did streamline one regulatory process and formalize another.

1. *Modern communications technologies are an ever-increasingly critical part of our everyday lives and play a vital role in the execution of our businesses and daily affairs. The number and types of radiofrequency (RF) devices have proliferated, and the ways we interact with them are continuously changing. As a result, our environment is populated with RF sources, at times located in close proximity to humans. The National Environmental Policy Act of 1969 (NEPA) requires the Commission to evaluate the effects of our actions on the*

quality of the human environment, including human exposure to RF energy emitted by Commission-regulated transmitters and facilities. The Commission has accordingly promulgated rules that set limits for RF exposure and, through the years, has created a framework to ensure compliance with these limits. Today, we take a number of steps regarding these limits to ensure the health and safety of workers and consumers of wireless technology, while also clarifying and streamlining rules to reduce regulatory burdens on licensees.

2. *First, we resolve a Notice of Inquiry that sought public input on, among other issues, whether the Commission should amend its existing RF emission exposure limits. After reviewing the extensive record submitted in response to that inquiry, we find no appropriate basis for and thus decline to propose amendments to our existing limits at this time. We take to heart the findings of the Food & Drug Administration (FDA), an expert agency regarding the health impacts of consumer products, that "[t]he weight of scientific evidence has not linked cell phones with any health problems." Despite requests from some to increase and others to decrease the existing limits, we believe they reflect the best available information concerning safe levels of RF exposure for workers and members of the general public, including inputs from our sister federal agencies charged with regulating safety and health and from well-established international standards.*

3. *Second, based on our existing limits, we revise our implementing rules to reflect modern technology and today's uses. We streamline our criteria for determining when a licensee is exempt from our RF exposure evaluation criteria, replacing our prior regime of service-based exemptions with a set of formulas for situations in which the risk of excessive RF exposure is minimal. For those licensees who do not qualify for an exemption, we provide more flexibility for licensees to establish compliance with our RF exposure limits. And we specify methods that RF equipment operators can use to mitigate the risk of excess exposure, both to members of the public and trained workers (such as training, supervision, and signage).*

4. *Third, we notice further targeted proposals on the application of our RF emission exposure limits for future uses of wireless technologies. Specifically, we propose to formalize an additional limit for localized RF exposure and the associated methodology for compliance for portable devices operating at high frequencies (gigahertz (GHz) frequencies) on top of our already existing limits that apply at these frequencies, and propose to extend this to terahertz (THz) frequencies as well. We also propose to allow wireless power transfer (WPT) equipment under Parts 15 and 18 of the Commission's rules and propose specific exposure limits for such operations.*

5. *Fourth, and finally, we deny a pending petition for reconsideration and affirm our prior finding that the pinnae (outer ears) should be treated like other extremities for purposes of determining compliance with our RF emission exposure limits.*

The Commission's December action is supported by a fulsome public record of thousands of comments by experts and the general public in three dockets.

Food and Drug Administration

FDA has done significant scientific work on the question of the risk EMF emissions may pose for living organisms. The FCC relies in part on the FDA recommendations. Three publications stand out in FDA's recent work, one oriented toward consumers and the other two for the scientific audience.

"Do Cell Phones Pose a Health Hazard" is an easily approachable web page for consumers and others learning about this issue.

On the more scientific front, FDA's Scientific Evidence for Cell Phone Safety provides more in-depth analysis.

FDA's Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer is an outstanding piece of analysis. It examines all relevant research published over the ten-year period based on *in vivo* (live animals) or epidemiological research.

For *in vivo* review FDA finds:

> *C. Conclusions from In vivo Review.*
>
> *The in vivo studies conducted between January 1, 2008 and August 1, 2018 and summarized here have contributed to our collective understanding of the potential effects of RFR on mammals. Overall, based on certain limitations, these studies have not produced any clear evidence that RFR exposure has any tumorigenic effect. In some cases, the authors of these studies suggested the need for more research based on the reported results. Other authors stated that RFR exposure does not result in tumor-initiating or -promoting effects.*
>
> *Most of the referenced literature did not include measurement of animal temperatures. The impact of potential temperature elevation from RFR exposure is a confounding factor in such studies and critical to assess. The NTP reports examined temperature increases in their 5-day pilot study. However, they did not adjust their highest exposure groups, exposures up to 6 W/kg in rats and 10 W/kg in mice, to address concerns with geriatric thermoregulation. The NTP pilot study confirms that pregnant animals and older animals have difficulty regulating body temperature when they are exposed to sources of heat such as RFR exposure. NTP reports indicate a need to further evaluate how mammals' thermoregulatory abilities decline as they age and how to address this issue to remove confounding heating as a factor in any future RFR exposure research. Similarly, some of the other literature we reviewed have results that are confounded by heating issues.*
>
> *As with many areas of active investigation, the variety of experimental methods employed can result in significant differences in conditions experienced by the experimental animals, and in turn this can lead to a high degree of variability in study conclusions. For RFR studies, there are large differences in, for example, methods for dosing and restraining animals during the experimental procedure that will affect the specific stress levels of the test animals, confounding some conclusions. There are also important differences in the overall experimental designs, including the use (or lack) of both a control and sham exposed control group. Such differences may be one*

reason why there are many diverging and conflicting conclusions of the in vivo effects of RFR.

Another experimental issue that has an impact on the understanding of the interaction between RFR with animals and needs further research is how samples are handled and evaluated. The method of sacrifice (time since last exposure) and time from an animal's death to sample preparation have a large impact on the results of sensitive tests like the comet assay. In these experiments, there were differences in how biological samples were collected and processed that added confounding factors. One of the most prevalent problems we observed in these studies was the lack of adequate blinding of samples which generally leads to an unconscious bias in the evaluation of data. More clarity regarding potential confounders is needed in this area of research.

The FDA has followed RFR research developments for over 20 years. More than 100 peer reviewed articles about in vivo animal exposures were assessed for to determine if they met the scope of this review. 37 peer reviewed articles met our criteria and are included in this review. In vivo studies are of great value and contribute to our understanding of this topic. However, as described above, due to the critical limitations of in vivo studies in assessing the effects of RFR exposure to humans (e.g., whole-body RFR exposure), we cannot draw conclusions about the impact of such exposure to humans based on these in vivo animal studies. The results from such studies should not be applied to human cell phone usage as further research is needed.

On the epidemiological side FDA makes a similar finding:

E. Conclusions from Reviewed Epidemiological Studies

In summary, the epidemiological data published between January 1, 2008 to May 8, 2018, continue to support the FDA's findings that there is no quantifiable causal link between RFR exposure and tumor formation. The data suggest the need for shifting the focus from the general population with undetectable overall risk to a very small subset of people who might be inherently predisposed to the risk for tumorigenesis and who therefore might be more susceptible to putative risk modification by the intense RF-EMF exposure. The currently available epidemiologic studies lack evidence stratified by the inherent tumorigenesis risk. In addition, as stated in the NCI-issued fact sheet on cell phones, direct measurements of RF exposure are not yet possible outside of a laboratory setting, which further prevents collection of an adequate RF-related evidence in epidemiological studies.

Further, existing epidemiologic evidence is insufficient to suggest that use of cell phones can be considered as an independent etiological factor capable of influencing the incidence of intracranial and some other tumors in the general population. Existing epidemiological evidence indicates that if any risk does exist, it is extremely low compared to both the natural incidence of the disease and known controllable risk factors. As further research is conducted, we will continue to monitor the available information.

FDA's analysis was based on the most recent of the more than 30,000 EMF studies indexed by Medline and EMF Portal, open repositories used by all EMF researchers. Caveats of this research: FDA only looked at cancer-related research; it relied on peer-reviewed papers (plus one government study done by NTP); it exclude evidence from EMF emissions above 6 GHz, and it did not concern itself with the typically unreliable *in vitro* (cells in petri dishes) preferred by petitioners.

FDA's focus was to look for evidence of cancer in scenarios that resemble real-world use of cell phones by normal people; it did not examine artificial scenarios that induced cancer by exposing test subjects to unrealistic levels of whole-body EMF emissions as NTP did.

International Commission on Non-Ionizing Radiation Protection

ICNIRP is a 48-year-old international science non-profit that advises the World Health Organization and other organizations on standards exposure to EMF emissions. It is the world's leading expert on non-ionizing radiation from 0 Hz to 100 GHz, far below and far above the frequency range used by 5G (700Mhz-37GHz in the US.)

ICNIRP published an update to its "ICNIRP Guidelines for Limiting Exposure to Electromagnetic Fields (100 KHz to 300 GHz)" in March, 2020.

> *Abstract—Radiofrequency electromagnetic fields (EMFs) are used to enable a number of modern devices, including mobile telecommunications infrastructure and phones, Wi-Fi, and Bluetooth. As radiofrequency EMFs at sufficiently high power levels can adversely affect health, ICNIRP published Guidelines in 1998 for human exposure to time-varying EMFs up to 300 GHz, which included the radiofrequency EMF spectrum. Since that time, there has been a considerable body of science further addressing the relation between radiofrequency EMFs and adverse health outcomes, as well as significant developments in the technologies that use radiofrequency EMFs. Accordingly, ICNIRP has updated the radiofrequency EMF part of the 1998 Guidelines. This document presents these revised Guidelines, which provide protection for humans from exposure to EMFs from 100 kHz to 300 GHz.*
> *Health Phys. 118(5):483–524; 2020*

The new ICNIRP guidelines are consistent with the FCC guidelines. To appreciate the thoroughness of the ICNIRP review, readers should consult Appendix B, Health Risk Assessment Literature.

> *The World Health Organization (WHO) has undertaken an in-depth review of the literature on radiofrequency electromagnetic fields (EMFs) and health, which was released as a Public Consultation Environmental Health Criteria Document in 2014. This independent review is the most comprehensive and thorough appraisal of the adverse effects of radiofrequency EMFs on health. Further, the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), a European Commission initiative, also produced a report on potential health effects of exposure to electromagnetic fields (SCENIHR 2015), and the Swedish Radiation Safety Authority (SSM) have produced several international reports regarding this issue (SSM 2015, 2016, 2018). Accordingly, the present guidelines have used these literature reviews as the basis for the health risk assessment associated with exposure to radiofrequency EMFs rather than providing another review of the individual studies. However, for completeness, ICNIRP considered more recent research published after the reviews from WHO, SCENIHR and SSM in the development of the current guidelines (cut-off date September 1st, 2019). The discussion of ICNIRP's appraisal of the radiofrequency*

> *health literature below provides a brief overview of the literature, a limited number of examples to help explain the overview, and the conclusions reached by ICNIRP…*
>
> *SUMMARY*
>
> *The only substantiated adverse health effects caused by exposure to radiofrequency EMFs are nerve stimulation, changes in the permeability of cell membranes, and effects due to temperature elevation. There is no evidence of adverse health effects at exposure levels below the restriction levels in the ICNIRP (1998) guidelines and no evidence of an interaction mechanism that would predict that adverse health effects could occur due to radiofrequency EMF exposure below those restriction levels.*

Like the FCC, ICNIRP found no scientific reason to adjust non-ionizing radiation guidelines set in the 1990s.

World Health Organization

On February 27, 2020 WHO published the following advice on 5G networks and public health:

> ***What are the main differences between 5G and previous technologies?***
>
> *5G represents an evolution in telecommunication standards. To enable increased performance, 5G will extend into higher frequencies around 3.5 GHz and up to a few tens of GHz. The higher frequencies are new to mobile phone networks, but are commonly used in other applications, such as point-to-point radio links and body-scanners for security checks.*
>
> *At these higher frequencies, 5G networks will use a greater number of base stations and of connected objects. 5G will further employ beam-forming antennas to focus signals more efficiently towards the device in use, rather than having the signal spread in broad directions as in current base station antennas…*
>
> ***What are the potential health risks from 5G?***
>
> *To date, and after much research performed, no adverse health effect has been causally linked with exposure to wireless technologies. Health-related conclusions are drawn from studies performed across the entire radio spectrum but, so far, only a few studies have been carried out at the frequencies to be used by 5G.*
>
> *Tissue heating is the main mechanism of interaction between radiofrequency fields and the human body. Radiofrequency exposure levels from current technologies result in negligible temperature rise in the human body.*
>
> *As the frequency increases, there is less penetration into the body tissues and absorption of the energy becomes more confined to the surface of the body (skin and eye). Provided that the overall exposure remains below international guidelines, no consequences for public health are anticipated.*

Like ICNIRP, FCC, and others, WHO realizes that mmWave frequencies used by some 5G implementations reflect off the skin instead of penetrating it. The body repels mmWaves in much the same way that it repels sunlight.

WHO has a broader focus than FDA and FCC, considering speculative non-thermal effects of non-ionizing radiation in additions to scientifically valid thermal effects.

European Commission - Scientific Committee on Emerging and Newly Identified Health Risks

The European Commission's lead consultant body on EMF emissions, SCENIHR, published an important document in 2015, "Potential health effects of exposure to electromagnetic fields (EMF)" clarifying the source of health risks in mobile radio systems. The document focuses on radiation from personal devices because environmental EMF pollution from cell towers is negligible compared to radio and television broadcasts.

> ***Exposure***
>
> *In the radio frequency (RF range), by far the most applications which emit EMF are in the frequency range above 100 kHz up to some GHz. Multiple sources exist that contribute to an individual's exposure. However, transmitters in close vicinity to or on the body have become the main sources of exposure for the general population and professionals. Distance to the source is the main determinant of exposure, together with emitted power and duty factor.*
>
> *In particular for brain tissues, the mobile phone used at the ear remains the main source of exposure. However, since the first generation of mobile telephony, the technology aimed at reducing the emitted power of mobile handsets. Digital Enhanced Cordless Telecommunications (DECT) phones are another source of everyday exposure.*
>
> *Smart-phones, which operate within networks of different technologies, as well as other portable wireless devices, like tablets and laptop computers, increased the complexity of the user's exposure and changed the exposed body region. Due to the different sources used next to the body, it is important to take into account multiple exposures for risk assessment, which may also require organ-specific dosimetry. This issue is also important for occupational exposure, since there may be situations, such as working in an MRI suite, where professionals are exposed simultaneously to EMF of multiple frequencies ranges, different temporal variations and field strengths.*
>
> *The environmental exposure from sources is dominated by broadcasting antennas, antennas from private and governmental telecommunication services and mobile communications base stations. Historical data from spot measurement campaigns and continuous radiation monitoring systems indicate that the introduction of new mobile telecommunication technologies after the deployment of the GSM and UMTS systems did not substantially change the average levels of EMF in the environment. At the same time, other technologies, like digital broadcasting, have in some regions contributed to the reduction of EMF exposure from far field sources.*
>
> *The number of sources has increased indoors. The installation of access points and short range base stations, such as 3G femtocells, WiFi hotspots and DECT devices, has given rise to exposure at very close distances (within 1 m), whereas farther away the emitted EMF does not exceed the common background levels. Consequently, the emitted EMF from these devices, even when combined, still results in a marginal*

> *exposure compared to reference levels of European and international guidelines. In general, it appears that, with respect to telecommunication applications, the technological trend is to use low-power emitters, closer to or on the human body, and at higher frequencies.*
>
> *Millimetre wave and THz applications are expected to be available soon in various industrial environments, such as for imaging systems used for non-destructive quality control, as well as for short-range broadband telecommunications. Currently, they do not significantly affect the average exposure of the general public. These applications will operate with low power and, due to the small penetration depth of the radiation, expose only superficial tissues.*

Like WHO, SCENIHR examines speculative non-thermal effects of non-ionizing radiation in additions to scientifically valid thermal ones.

Lakewood Broadband

While FCC, FDA, ICNIRP, WHO, and SCENIHR have one view on the fundamental safety of the 5G network, a local pressure groups sees things differently. LakewoodBroadand.org is a website controlled (apparently, as it publishes no names) by Lakewood citizens Carol Baum, Lynn Judson, Linnea Hauser, and friends. Ms. Judson has told the Council she suffers from Electromagnetic Hypersensitivity Syndrome (EHS,) condition with no known medical basis.[1]

If EMF emission were the cause of this condition, it would follow that EHS sufferers would welcome 5G, as it sharply reduces EMF absorption over 3G and 4G wireless systems. But Lakewood Broadband is entirely critical of 5G, even claiming that networks built entirely on the fiber optic cables that are an element of the 5G network are a wholesale substitute for it.

Lakewood Broadband doesn't address the question of how fiber optic cables can provide mobility, but the answer is clear: fiber provides backhaul for cell towers, both large and small, and it provides Internet connections for Wi-Fi routers and wireless femto-cells in the home and office.

Fringe Science

Lakewood Broadband promotes fringe science published on non-peer-reviewed platforms such as blogs, YouTube, and the popular press. Its initial blog post, signed by Ms. Judson, touts the work of Devra Davis Ph.D. (former scientist turned movie producer, public speaker, and writer of a popular book on the hazards of wireless networks and retired professor Dr. Martin Pall. Its collection of research on the hazards of radio networks highlights their work as well as that of retired Georgia Tech School of Public Policy Research analyst Ronald N. Kostoff Ph.D., and retired University of Albany Institute for Health and the Environment professor Dr. David O. Carpenter.

Devra Davis, Ph.D.

Davis is the rock star of the anti-radio cause. She rose to prominence in 2007 when she published a scathing attack on prominent epidemiologist Sir Richard Doll in her book *The Secret History of the War*

[1] WHO has held workshops on EHS reaching the conclusion that EMF mitigation does not help EHS sufferers: "EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem."

on Cancer. Davis claimed Doll's discovery of the "link between tobacco and lung cancer in 1955 had been influenced by earlier German studies in the 1930s that he had not acknowledged."

Building on the theme of secret hazards, Davis published *Disconnect: The Truth About Cell Phone Radiation, What the Industry Has Done to Hide It, and How to Protect Your Family* in 2010. The book is widely regarded as "an attempt to bamboozle and scare the lay reader, not to inform" reflecting a poor understanding of both the cellular network and epidemiology. (See "A Disconnect between cell phone fears and science" in *Science Based Medicine*.) It was obviously not peer-reviewed.

Disconnect cherry-picks both the published and unpublished science literature in an attempt to build a case against the cell network. By and large, Davis gives much more credence to non-reproduceable fringe science than to mainstream, replicated work. She claims, for example, that all long-term epidemiological studies of heavy cell phone users show harm:

> *But when you look at those few studies that included people who had used phones for a decade or more, the results show that heavy cell phone use causes brain tumors…if you examine only those studies that have analyzed people for a decade or longer you find one thing: Every single one of them shows that long-term heavy use of cell phones has increased the risks of brain tumors.(p 173)*

This is not the case. Some studies show a weak correlation between long-term, heavy use but most don't. The Interphone study group report, "Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study", concluded that Davis' claim is false:

> *Overall, no increase in risk of glioma or meningioma was observed with use of mobile phones. There were suggestions of an increased risk of glioma at the highest exposure levels, but biases and error prevent a causal interpretation. The possible effects of long-term heavy use of mobile phones require further investigation.*

While some studies of long-term cell phone use billing records to establish extent of use, others rely on user recall, a very unreliable source of data. Davis places excessive credence on recall studies (especially those of Swedish researcher, Dr. Lennart Hardell) and essentially ignores records-based studies such as the Danish study, "Cellular Telephone Use and Cancer Risk: Update of a Nationwide Danish Cohort."

This study was entirely record-based, and subjects were not even aware that their data was included in it. This extraordinary access had to be approved by the government of Denmark as it relied on both cellular billing records and medical records.

While Davis mentions this study, she misrepresents it, claiming it only included two long-term users instead of the 53,204 long-term users among the 420,000 users it surveyed.

As Lorne Trottier concludes in his review of *Disconnected*, Davis appears to have an intent to deceive that has infected the entire anti-EMF movement:

> Disconnect *is a good example of the kind of material used by the EMF alarmist movement. Virtually all the alarmist studies that Davis cites used a poor methodology and/or have not been replicated in follow up studies. In fact, most have been refuted by far more comprehensive and rigorous studies. In many cases, serious flaws have been found with studies that show harm. It is at odds with the conclusions of mainstream expert groups such as the SCENHIR:*[5]

> *"It is concluded from three independent lines of evidence (epidemiological, animal and in vitro studies) that exposure to RF fields is unlikely to lead to an increase in cancer in humans."*

Cherry-picking and misrepresentation make something out of nothing.

The Three Retirees

Retired professors and researchers are especially prominent on the scientific fringe and the anti-EMF movement makes much use of them.

Ronald N. Kostoff Ph.D.

Former Georgia Tech School of Public Policy Research analyst Kostoff specialized in performing keyword searches of science research databases in order to find fringe work that supported whichever thesis he was promoting. In a chapter of *Microwave Effects on DNA and Proteins* titled "Modified Health Effects of Non-ionizing Electromagnetic Radiation Combined with Other Agents Reported in the Biomedical Literature" Kostoff describes his method as "text-mining", a higher-sounding name than "cherry-picking:"

> *Text mining is the extraction of useful information from large volumes of text (Hearst; Feldman et al.; Kostoff et al.). Its component capabilities of computational linguistics and information retrieval were the main analytical techniques used in the present chapter. A typical text mining study of the published literature involves the development of a query for comprehensive information retrieval, an analysis of the database using computational linguistics and bibliometrics, and an integration of the processed information.*

This is a degenerate form of science that excludes mainstream findings in favor of confirmatory ones. Because Kostoff's automated method allowed him to produce a large number of extremely low-quality reports, his work is generally ignored by mainstream science.

David O. Carpenter, MD.

Carpenter is a frequent guest on RT America, the Russia-sponsored misinformation-based television network that has played a prominent role in revving-up the anti-EMF movement. Lakewood Broadband promotes a letter to the editor he and his Australian colleague wrote to Science Direct on 2019, "Causes of cancer: Perceptions vs. the scientific evidence".

Carpenter is upset with a psychological study, "Prevalence of beliefs about actual and mythical causes of cancer and their association with socio-demographic and health-related characteristics: Findings from a cross-sectional survey in England."

The study explores reasons people fear such things as "drinking from plastic bottles; eating food containing artificial sweeteners; eating genetically modified food; eating food containing additives; using microwave ovens; using aerosol containers; using mobile phones; using cleaning products; living near power lines; feeling stressed; physical trauma; exposure to electromagnetic frequencies, i.e. non-ionizing radiation of low and high frequencies such as WiFi and Radio/TV frequencies" as cancer risks while not fearing genuine hazards such as "active and passive smoking, alcohol consumption, overweight and obesity, physical inactivity, poor diet, exposure to ultraviolet radiation, and human papillomavirus (HPV)."

The study found that more people knew about the genuine hazards than the mythical ones by a margin of 53% to 36%, a gap researchers found much too narrow. In particular, they were disturbed that obesity, the second largest preventable cause of cancer in England, was poorly recognized.

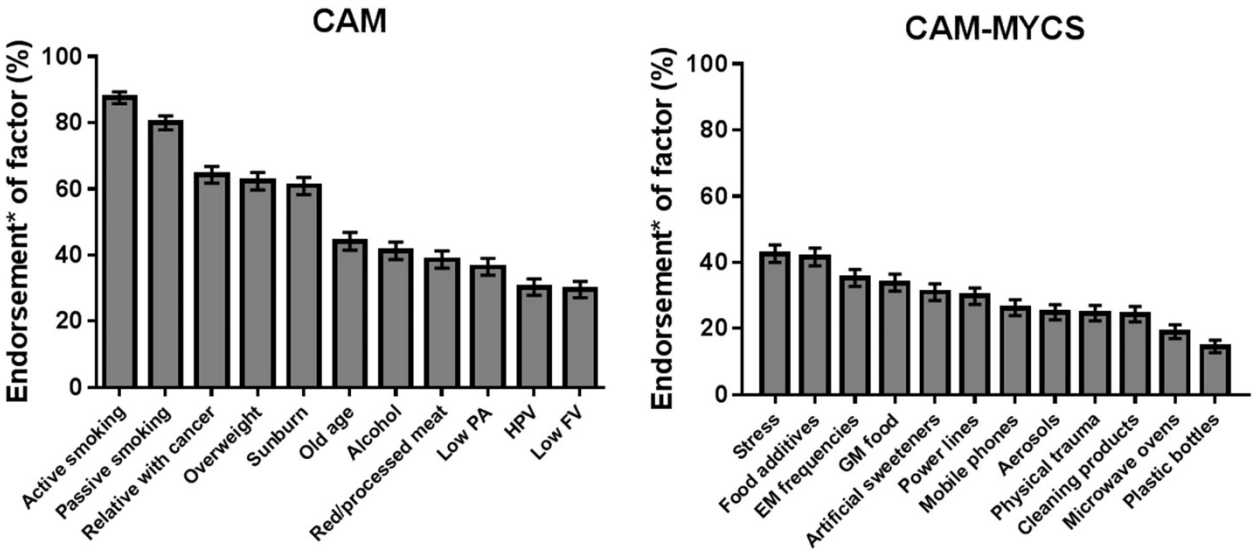

*Figure 3 Endorsement of actual and mythical causes of cancer in England. *This is the percentage of participants who chose either 'agree' or 'strongly agree' for actual (CAM) or mythical (CAM-MYCS) cancer causes. PA, physical activity; HPV, Human Papilloma*

EM frequencies and genetically modified foods, both bugaboos of Lakewood Broadband founders, ranked third and fourth in the mythical cause endorsement list.

Carpenter is having none of this. He declares classifications by the International Agency for Research on Cancer (IARC) that Extra-Low Frequency Radiation (ELF, essentially power lines) and Radio Frequency (RF) are "possible carcinogens" (Group 2B) is scientific proof of cancer risk. But IARC doesn't do research nor does it assess risk.

Rather, it reviews scientific literature for evidence that the substances and activities it assesses are hazardous. Hazard exists where it's possible for the substance or activity to cause cancer under any circumstances at all, including over-exposure. Risk is the more sober assessment of whether the hazard is likely to materialize under ordinary conditions in ordinary exposures. Hence, in nearly 1,000 assessments IARC has only made one finding that the subject under test was completely free of hazard.

Carpenter also asserts that a study of rats over-exposed to 2G signals conducted by the US National Toxicology Program (NTP) showed clear evidence of carcinogenicity when it found no effect among seven of eight test groups and longer lives among the remaining test subjects, male rats exposed to CDMA-modulated signals. Given that controls lived shorter lives that test subjects and cancers are more prevalent as animals age, NTP's findings are inconclusive at best.

The NTP study is not taken seriously by international researchers because of its poor design – full body exposure at levels 800 times higher than real world conditions - and inconclusive findings. It was not accepted for publication by any peer-reviewed journal. But it is cited in Lakewood Broadband's "The Science on Wireless Radiation" handout.

A similar story can be told about Carpenter's claim around a study by the Ramazzini Institute in Italy that was rushed to publication following the release of the NTP's results. While Ramazzini claimed to have

replicated NTP's findings, there are significant inconsistencies between the two studies, both in terms of study design and in terms of results.

While NTP tried to examine near-field exposure – effects of cell phones on users – Ramazzini tried to model far-field exposure, from tower to user. Hence, Ramazzini chose exposure levels 1,000 times lower than NTP. Ramazzini produced only one consistent result, a statistically significant – but still small – increase in heart Schwannomas in male rats.

While NTP found three malignant gliomas in the brains of male rats, Ramazzini found none. And to confound the mystery, Ramazzini found an increase in malignant glial tumors in the brains of female rats but not in males. This increase was not statistically significant, however.

The presence of heart Schwannomas in the male rats exposed to CDMA in the NTP study and to all male rats in the Ramazzini study is puzzling. Both studies exposed the full bodies of rats to EMF emissions, and Schwannomas can appear in any organ. So why did they only appear in heart tissue? The fact that Schwannomas preferentially appeared in the rats' hearts and not in any other organ exposed to EMF suggests a secondary cause, or, more likely random chance. The number of affected test subjects was extremely small in both studies.

The fact that tumors appeared in similar rates across studies with exposures differing by a factor of 1,000 also confounds the expectation of a dose response in most toxicology studies. Ramazzini only found tumors in subjects exposed to their highest dosage level. The differences between the two studies and the large number of types of cancers researchers looked for suggest that the effect was random. Nevertheless, Lakewood Broadband features the Ramazzini study in its handout.

Martin Pall, Ph.D.

Pall is the originator of the claim that 5G is the cause of the COVID-19 pandemic. He is a retired professor of biochemistry and basic medical sciences at Washington State University, who specialized in chronic fatigue syndrome, multiple chemical sensitivity, and the effects of low intensity microwave frequency electromagnetic fields (MWV-EMF) on the human body. The Guardian says: "Pall's research interests are practically an encyclopaedia of the medical counterculture." The Guardian also considers Pall to be the godfather of the 5G Truther movement:

> *In a 90-page self-published document posted online last May, Pall gave the rallying cry for the 5G opposition: "Putting in tens of millions of 5G antennas without a single biological test of safety has got to be about the stupidest idea anyone has had in the history of the world," he wrote. That line has been widely quoted, everywhere from the r/conspiracy subreddit to the House of Commons, where Antoniazzi approvingly quoted Pall to accuse the government of "sweeping the health concerns under the carpet".*

Lakewood Broadband prominently links to this paper on a page titled Health Studies. This screen capture was taken on June 7, 2020.

Figure 4 Screen capture of Lakewood Broadband link to Martin Pall paper

Pall claims that SARS-CoV-2 originated in Wuhan China because the city is a 5G testbed. In an article titled "Argument for a 5G – COVID-19 Epidemic Causation Mechanism" he draws the following conclusion:

> *It is my opinion, therefore, that 5G radiation is greatly stimulating the coronavirus (COVID-19) pandemic and also the major cause of death, pneumonia and therefore, an important public health measure would be to shut down the 5G antennae, particularly the small cell 5G antennae in close proximity to our homes, schools, businesses, houses of worship and hospitals.*

Pall has also predicted that areas with no 5G would not be affected by the virus; in Role of 5G in the Coronavirus Epidemic in Wuhan China he wrote:

> *These all argue that 5G radiation is likely to greatly exacerbate the spread of the coronavirus and to greatly increase the lethality of the infections produced by it. The good news is that it is likely that those of us that live in areas with no 5G radiation and who avoid other EMFs wherever possible will probably escape much of the impacts of this prospective global pandemic. It is highly probable that one of the best things Wuhan can do to control the epidemic in the city is to turn off the 4G/5G system.*

Needless to say, these predictions have not been borne out by events. Consequently, Pall's prediction in Massive Predicted Effects of 5G in the Context of Safety Guideline Failures: "All of this argues that 5G presents threats of the sort that we have never seen before – multiple imminent existential threats to our survival" should be disregarded.

Study Session: Productive Activity or Waste of Time?

Some council members have proposed a study session on small cell siting regulations, on the apparent theory that "credible voices on both sides of the debate" need to be heard. I dispute the assumption that any credible, qualified parties are pushing Lakewood to halt the deployment of small cells, enforce

arbitrary spacing requirements, or require unnecessary setback provisions. There is not equal truth on both sides of the question of 5G. Unlike politics, science is not about opinion, it's about rational theory supported by evidence.

With respect to Lakewood Broadband and similar citizen groups, opposition to small cells is confined to a segment that can only be described as fringe, if not lunatic fringe. The scientists that have energized the 5G Truther movement with claims that 5G caused the COVID-19 pandemic and that all radio-based data networks pose unacceptable risks to the human and animal populations are simply not credible. Indeed, many of them have been shown to have committed misconduct or to be playing fast and loose with the truth.

Virtually every public health regulator in the world has deemed the 5G network safe. Because these limits are 50 times more stringent than they need to be, even faulty equipment cannot cause a public health risk. There is no need to second guess expert regulators in Washington DC and the rest of the world on this matter.

FCC General Counsel Thomas M. Johnson published an op-ed in the *Washington Post* on June 4th, addressing the efforts of 5G Truther movements across the country, aptly titled "5G conspiracy theories threaten the U.S. recovery." Chief Counsel Johnson reaches a cogent conclusion with direct relevance to Lakewood:

> *Bad local decisions could be catastrophic for our country as we continue to face historic challenges relating to the coronavirus pandemic. High-speed, high-capacity wireless networks will be indispensable tools for our social and economic recovery. Under Chairman Ajit Pai, the FCC has spent the past three years freeing up airwaves and cutting red tape to ensure that American networks are prepared for this crisis. But if we delay 5G deployment based on irrational fears and unproven theories, it will only hurt the American people as we plot our path forward.*

I encourage Council to read the full article.

The question before the council is whether it is willing to do real damage to the post-pandemic recovery on the basis of wild speculation about unproved harms. Fears have been ginned up by a movement created by charlatans to deceive and victimize ordinary, well-intentioned, honest citizens. Make no mistake about it: the 5G Truther movement is all about the desire of a handful of promoters to capitalize on the general public's poor understanding of science and technology.

This is a theme that plays out across the world everyday over issues such as climate change, immunization, genetic engineering and other forms of biotechnology, Internet privacy, and broadband Internet policy generally.

Recent events in Lakewood suggest that a study session that gives equal time to both sides of the science vs. hysteria debate will not be productive. Ward 1 recently held a Zoom dialog featuring two neutral city employees and one representative of Lakewood Broadband. While billed as a point-counterpoint discussion, the agenda enabled Lakewood Broadband to make a series of false claims with no rebuttal from the panel. At best, 5G Truthers represent a fraction of one percent of credible opinion on the impact of 5G on the public and the economy. In no rational universe should they be allowed 95% of the time in any public forum.

The city and the nation face a real, immediate, and crucial challenge as we struggle to re-open the economy, deal with massive unemployment, and pay down our now gargantuan debt. Slowing the

recovery in a vain attempt to appease a cabal of under-informed, highly privileged narcissists is not the way to move the ball forward. We need the jobs and the economic growth that will come in both the short and long terms from investment in 5G. No amount of appeasement will satisfy 5G Truthers in any case.

Don’t make Lakewood a national laughingstock. Please approve the small cells siting measure without setback or spacing provisions.

Sincerely yours,

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