Analysis of 5G and Its Implications in the UK

by

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1.0 Summary of 5G Analysis

1. **Very real, negative non-thermal biological effects** occur as a direct result of **extremely low** electromagnetic radiation (EMR) levels, which are several orders of magnitude lower than the current safety limits set by the International Commission for Non-ionising Radiation Protection (ICNIRP).

2. Public Health England (PHE) relies entirely on ICNIRP safety guidelines on EMR radiation have been shown to be **deeply flawed** – see Pall, M. (2018) [(1)] and Hardell & Nyberg (2020) [(3).] and Naren et al. (2020) [(24).]

3. The ICNIRP safety guidelines are **flawed** because:
    a. They **assume average EMR intensities and average SAR** can be used to predict biological effects and therefore safety. In fact, negative non-thermal biological effects occur approximately 100,000 times below current allowable levels.
    b. They **ignore demonstrated biological heterogeneity** and **established biological mechanisms**
    c. They **ignore pulsed EMR** which is much more biologically active than are non-pulsed EMR of the same average intensity
    d. They **ignore complex sinusoidal dose-response curves**
    e. They also **ignore many important scientific reviews which show non-thermal negative biological effects** caused by EMR (see body of evidence in Tables 1,2 & 3)
    f. There are many articles which state that EMRs produce diverse non-thermal effects through voltage gated calcium channels (VGCCs) in cells and produce negative biological effects such as oxidative stress, cellular DNA damage and increased calcium signalling but the **voltage sensor of the VGCC is ignored by the 2020 ICNIRP safety guidelines**. (see the following articles for which Pall,M. 2018 [(1)] & Doyon PR et al, (2017) [(8)] Herbert MR & Sage C (2013) [(15)],Panagopoulos et al (2002) [(30)].

4. **Negative non-thermal biological effects of EMR** listed in the literature across humans and other species are: (see Tables 1, 2, 3 below and Pall (2018) [(1)])
    a. Lowered adaptive immune responses or immune system dysregulation
    b. Cardiac effects, including tachycardia, bradycardia and arrythmias, and ventricular developmental defects
    c. Cancer including initiation, promotion and progression
    d. Pathological damage to multiple organs (e.g. liver, kidneys, uterus, bladder, testis)
    e. Trace element disturbances in tissues
    f. Ocular damage
    g. Lowered fertility
    h. Hormonal dysregulation
    i. Neurological / neuropsychiatric effects
    j. Sleep disruption
    k. Memory, motor skill, attention, cognition impairment
    l. Apoptosis / programmed cell death
    m. Oxidative stress / free radical damage
    n. Single strand and double strand breaks in cellular DNA
    o. Increased intracellular calcium levels causing chronic effects

5. Considering all of the above negative effects of lower intensity electromagnetic radiation already out there, many scientists globally have asked for a **moratorium on the deployment**

of 5G until the electromagnetic radiation risks associated with this new emerging technology have been fully investigated by industry-independent scientists, but this is falling on deaf ears. The responses from the EU seem to have thus far prioritized industry profits to the detriment of human health and the environment. Hardell & Nyberg (2020) [3]

6. This means that the current situation in the United Kingdom is a **violation of Human Rights** similar to that which has been tabled to the United Nations Human Rights Council in early 2019 for Australia by S.J. Toneguzzo. (See below UN NGO document link, page 24)

7. The **deployment of 5G without safety testing in the UK violates over 15 international agreements**, treaties and recommendations, including article 7 of the International Covenant on Civil and Political Rights and principle 9 of the Declaration of Helsinki of 1964. (links listed on page 24 below)

8. **Wireless carriers have already conceded** to U.S. Senator Richard Blumenthal that they are **not aware of any independent scientific studies on the safety of 5G technologies** – see reference 13 below. They are also making misleading comments about the safety of 5G – see comment by Dr Jack Rowley below, page 28).

9. Existing low level EMR is having damaging biological responses such as those listed in point 4 above, so untested frequencies such as 5G, means that we should be invoking the **precautionary principle on 5G**, and **re-evaluating and revising current safety limits,** as well as putting a moratorium on the roll out of 5G. Naren *et al*. (2020) [23] have stated that 5G should only be deployed after having completed thorough research and well-designed safety testing, as the EMR exposure levels they see with 2-4G are well over the safe limits set by Building Biology standard (BB), Austrian Medical Association (AMA), and the BioInitiative standards which do take into account non-thermal negative biological EMR effects but have 1000 fold lower limits (see Table 4).

10. The **precautionary principle has already been applied** by multiple local city councils in England (Brighton, Hove, Devonshire, Shepton Mallet, Somerset, Frome, Totnes, Wells, Glastonbury, Trafford) as well as other rightly concerned countries like Nigeria, Slovenia, etc. – see URL links 11 and 12 in References for a full list.

11. A**dequate safety testing needs to be done for 5G**, and **current safety limits re-evaluated** in the light of the overwhelming body of current scientific literature which points to non-thermal negative biological responses across multiple species (see Tables 1, 2, 3), not just human beings. (see also letter to House of Commons from Radiation Research Trust requesting safety testing in reference 14 below) Naren *et al.* (2020) [24] state that "If 5G networks are deployed without careful analysis of expected exposure levels, almost all people in the area of coverage **may be exposed to dangerous levels of power flux density**, the outcomes of which, in the near future, may turn out to be **calamitous.**" They strongly suggest that a study similar to theirs be conducted in countries which choose to deploy 5G, by correlating the findings with the Basic Biology Standard, the Austrian Medical Association standard (AMA) and the BioInitiative standard (see Table 4) in order to get a consistent view of radiation exposure in 5G networks as compared to previous generations. This would provide much-needed insight and caution to all countries that are yet to adopt 5G.

12. Only after safety testing of 5G had been done by the mobile and broadband industry and by independent non-industry scientists who have no economical allegiance or scientific bias towards such emerging technology, should 5G have even be considered to be deployed in

the UK. Any such safety testing data should be **independently verified by a non-industry scientific committee** (see page 30).

13. **Constituents should be informed of their rights and consulted** in those parts of the UK, for whom 5G has been rolled out, without safety testing, and **access to 5G should be halted**, until we are aware of the full impact of 5G on, not just humans, but also on all species. This is because we now know that existing low level EMR radiation, **is already damaging humans as well as less complex species such as plants, insects, birds and lower mammals** (see list of articles in Table 1, 2 & 3 and Naren *et al.* (2020) [(24)]).

14. Much of the latest scientific data on EMR exposure (see Tables 1, 2, & 3 and References section below) strongly suggest that we should be doing all we can, to **protect our public from harmful EMR exposure** as follows:

    a. Do **safety testing of 5G** before we authorise any further roll outs and putting a halt to the operation of existing installations until safety testing has been verified and approved by not just the mobile and broadband industry, but by a non-industry working group of scientists, physicians and members of the public who can assess the data independent of 5G manufacturers

    b. **Prioritise and incentivise the use of safer wired fibre optic solutions** in our homes, shopping centres, airports, hospitals, workplaces and schools

    c. Encourage families to protect their future generations by **minimising the use of portable devices which emit EMR** like mobile phones, tablets, laptops, etc. (see letter requesting the same in reference 14 below)

    d. Do **urgent research on the safety and efficacy of shielding methods** combined with the use of generators which emit weak pulses of similar frequency, intensity, and waveform with the **natural atmospheric resonances** - see Panagopoulos & Chrousos (2019) [(16)]

    e. Get a **better understanding of the molecular mechanisms underlying EMR potential challenges to not only a single system but to all our biological systems**, in order to improve preventive strategies - see Santini *et al*. (2018) [(17)]

    f. Put in place **mobile and broadband industry-independent safety and usage regulations to protect our public** (adults and children) and other species and advising appropriate restrictions on the use of EMR emitting mobiles and all portable devices in order to protect the health of all users, i.e. not with respect to only one organ but with respect to our bodies as a whole, as well with respect to the health of the delicate ecosystem around us – see multiple papers in Table 3 which show:
        i. working memory impairment in human beings with mobile phone use (Kalafatakis *et al*. 2017)
        ii. strong cancer causality with mobile phone use (Pareja-Peña *et al*. 2020)
        iii. negative physiological and morphological effects on multiple plants (Halgamuge MN. 2017)
        iv. cognitive and motor damage on insects (Shepherd *et al*. 2018).

    g. Naren *et al*. (2020) [(24)] have done a highly informative study of the **exposure from EMR across multiple wireless devices**. They have determined the radiation concern levels in several scenarios using a handheld radiation meter by correlating

the findings with several international standards, which are determined based on thorough scientific evidence They have **suggested individual and collective human-centric protective and preventive measures** that could be undertaken to reduce the risk of EMR absorption, but these are not fully protective for Electromagnetic Hypersensitivity (EHS) individuals, so these can only be looked upon as a non-comprehensive interim measure in an environment where wireless EMR radiation cannot be avoided due to the lack of a wired fibre optic infrastructure.

h. Barnes & Greenebaum (2020) [25] have also sought to give advice on how governments, mobile and broadband industry and associated regulatory bodies could assemble **EMR safety guidelines for individuals, mobile and broadband companies, and system operators**. They state that we don't yet know whether biological effects seen due to lower level, long term EMR exposure is resulting in medical problems for a much larger number of people. Therefore, governments need to **investigate long-term exposure to weak EMR, and put in place safety guidelines** to address this issue.

15. An independent scientific committee (ISC – see page 30) and PHE would be wise to:

i. **Re-evaluate the body of scientific evidence on extremely low EMR** (continuous and pulsed) which produces non-thermal negative biological responses across multiple species not just humans

ii. **Understand and communicate to the public** which safety guidelines most closely adhere to protecting our people from any further EMR damage (by evaluating also the rationale of the BB, AMA, and the BioInitiative standards which do take into account non-thermal negative biological EMR effects)

iii. **Work together with the scientists of other countries** who are currently assessing their exposure limits prior to rolling out 5G, to understand all the dangers of 2G-5G

iv. **Set up UK-specific EMR safety guidelines** based on what is found from the above exercise, and not just rely on the currently flawed ICNIRP guidelines (the new guideline could be then used as a gold standard globally)

v. Set up **new** individual, worker, manufacturer, public spaces and atmospheric **safety guidelines** for existing **2G-4G EMR** emitting portable and stationary devices, base stations and towers

vi. Use the protective and preventive measures from Naren *et al*. (2020) [24] in a **public information campaign to inform the UK population on the best methods of shielding themselves from existing 2G-4G EMR** in the absence of any other consensus (see Table 4 below)

vii. Set up a study similar to the one conducted by Naren et al 2020) [24], by correlating the findings with the BB, AMA, and the BioInitiative standards in order to get a **consistent view of radiation exposure for 5G as compared to previous generations.**

viii. Set up **new** individual, worker, manufacturer, public spaces and atmospheric **safety guidelines** for **existing 5G EMR** emitting portable and stationary devices, base stations and towers

ix. **Halt the operation of existing 5G installations** until safety testing has been verified and approved by not just the mobile and broadband industry but by a non-industry working group of scientists, physicians and members of the public who can assess the data independent of 5G manufacturers

x. **Contact the public in any area where 5G is going to be deployed or already deployed** and ask them if they still want to have the greater connectivity of 5G despite the potential long term harms associated with continuous exposure to the very high levels of power flex density emitted by 5G EMR. **Leave the choice to the public**, and where they still want access, ensure that 5G is made available only through wired fibre optic technology thereby protecting those members of the public who prefer not to be exposed, e.g. EHS individuals.

xi. **Take action now for all those persons with Electromagnetic Hypersensitivity (EHS)** where they have been already subjected to 5G to inform them that the existing 5G masts will be decommissioned and a wired fibre optic technology solution put in to replace 5G masts.

xii. If existing non-5G masts are within a few yards of a property, action should be taken immediately to rectify this as residential buildings and schools should be protected from close by sources of EMR radiation. Safe distances for these masts should be determined by the bodies that have created the Basic Biology Standard, the Austrian Medical Association standard (AMA) and the BioInitiative standard who truly recognise the non-thermal negative biological effects of EMR radiation.

16. We need to **vote with our feet and not upgrade our broadband and mobile connections to 5G services**, as the government is ignoring the scientific data pointing to real harm of EMR, and instead wants us all to move towards bundled products from our mobile providers that utilise the 5G networks to provide mobile operators a return on their investments.

17. We need to **object to the current masts which are being planned in all 5G testbeds** and insist that safety testing data is generated and made available for independent scrutiny as this government is not independent in its agenda towards 5G roll out.

18. We need to **inform the unaware public of the dangers of 5G** and its predecessors and ensure that they take protective action, vote with their feet with regard to future 5G connectivity and object as strongly as they can to their planning committees, councillors and MP's.

2.0 5G – Analysis

2.1 The Problem

The UK people and its government should **be deeply concerned** regarding the negative biological impact, that nationwide 5G roll out will have on the people of this country. As it stands, in the UK, 5G has already been rolled out in key cities **without any safety testing.** It is clear from the scientific literature that **very real, negative non-thermal biological effects** occur as a direct result of extremely low EMR radiation levels (Tables 1, 2 & 3). These levels are orders of magnitude lower than the current safety limits set by the ICNIRP (the body that PHE relies on to set safety EMR guidelines) and has **a direct consequence** on the health of our nation (see paper written to authorities of the EU by Martin Pall in 2018.[(1)]) **Industry profits need to stop being prioritised to the detriment of our human health**, **the environment and many species** (see Tables 1, 2, & 3) for a list of the species affected by EMR).

2.2 Flawed Safety Guidelines by a Non-independent, Closed Group of Scientists

Unfortunately for us, **current UK government safety guidelines on EMR, are** misguided by Public Health England, which relies on **deeply flawed** ICNIRP safety guidelines.

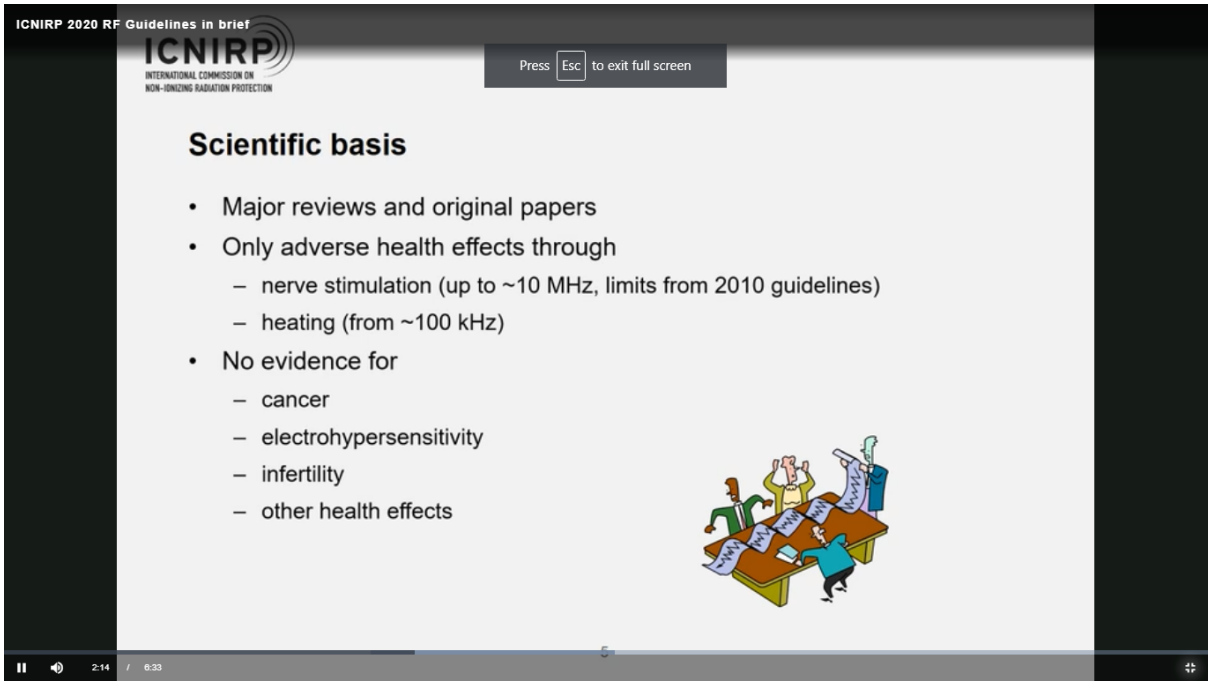
The reasons for this, are as follows:

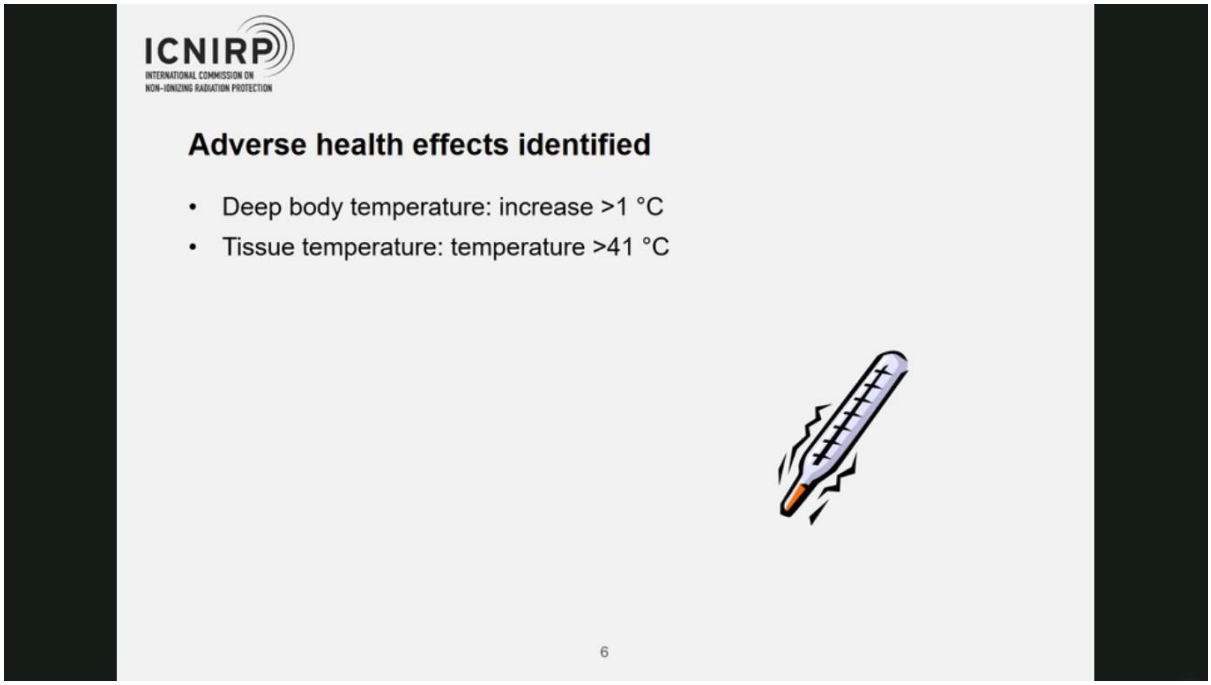
1. ICNIRP, US FCC, EU and other EMR safety guidelines are all based on the assumption that average EMR intensities and average SAR can be used to predict biological effects and therefore safety. Eight different types of quantitative or qualitative data have been analysed by Pall (2018) [(1) & (2)] to determine whether these safety guidelines predict biological effects. In each case the **safety guidelines fail** and in most of these, fail massively. Effects occur at approximately **100,000 times** below allowable levels (see also Tables 1, 2, & 3) and the basic structure of the **safety guidelines** is shown to be **deeply flawed**. The safety guidelines ignore demonstrated biological heterogeneity and established biological mechanisms. Even the physics underlying the safety guidelines is shown to be flawed. Pulsed EMRs are in most cases much more biologically active than are non-pulsed EMRs of the same average intensity, but pulsations are ignored in the ICNIRP safety guidelines despite the fact that almost all of our current exposures are highly pulsed. There are exposure windows such that maximum effects are produced in certain intensity windows and also in certain frequency windows but the consequent very complex dose-response curves are ignored by the safety guidelines. Several additional flaws in the safety guidelines are shown through studies of both individual and paired nanosecond pulses. The properties of 5G predict that guidelines will be even more flawed in predicting 5G effects than the already stunning flaws that the safety guidelines have in predicting our other EMR exposures.' – see Pall, M. (2018) [(1)]
2. Nine distinct types of repeatedly found patterns of evidence clearly show that the "safety guidelines" **do not predict biological effects**" as seen in Pall, M. (2018) [(1)] and Pall, M.(2019) [(2)]
3. Hardell & Nyberg (2020) [(3)] further state *"In an appeal sent to the EU in September, 2017 currently >260 scientists and medical doctors requested for **a moratorium on the deployment of 5G** until the health risks associated with this new technology have been fully investigated by industry-independent scientists. The appeal and four rebuttals to the EU over a period of >2 years, have not achieved any positive response from the EU to date. Unfortunately, **decision makers** seem to be **uninformed or even misinformed about the risks**. EU officials rely on the opinions of individuals within the ICNIRP and the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), most of whom have ties to the industry. They seem to dominate evaluating bodies and refute risks. It is important that these circumstances are described. In this article, the warnings on the health risks associated with RF presented in the 5G appeal and the letters to the EU Health*

Commissioner since September, 2017 and the authors' rebuttals are summarized. The responses from the EU seem to have thus far ***prioritized industry profits to the detriment of human health and the environment."***

4. The 2020 ICNIRP guidelines have been published in March, and state: "*For the purpose of determining thresholds, evidence of adverse health effects arising from all radiofrequency EMR exposures is considered, including those referred to as 'low-level' and 'non-thermal', and including those where mechanisms have not been elucidated.*

The online 2020 ICNIRP presentation on the latest safety guidelines by Eric Van Rongen, Chairman (https://www.icnirp.org/en/frequencies/radiofrequency/index.html) states that there is no evidence for cancer, electro hypersensitivity, infertility or any other health effects. The only adverse EMR radiation effects he acknowledges to exist are: **nerve stimulation** at <10MHz and **heating** at > 100kHz (see screenshots below).





He seems to be looking at a completely different set of biased scientific data to what is in Entrez Pubmed (https://www.ncbi.nlm.nih.gov/pubmed/) when a search for electromagnetic radiation is done.

Barnes & Greenebaum (2020) [25] state*: " … it is not clear whether the biological effects seen for lower levels of exposure and long-term exposure are not resulting in* ***medical problems for a much larger number of people****. Additionally, there seem to be a smaller number of "hypersensitive people" who have very real and serious problems that they believe are based on exposure to weak RF fields.* ***What is missing in the current guidelines or regulations are guidelines for long-term exposure to weak EMR."***

The ICNIRP safety guidelines further **ignores many publications which show non-thermal effects of EMR** - see pages 22-32 of Pall (2018). [1]

The ICNIRP group has been found to consist of a closed group on non-independent scientists with conflicts of interest, heavily funded in most cases by the mobile industry with a lack of biomedical expertise and a heavy bias in their interpretation of scientific data relating to electromagnetic radiation such that most industry-funded research is least likely to report results suggesting adverse health effects (see report below).

The International Commission on Non-Ionizing Radiation Protection: Conflicts of interest , corporate capture and the push for 5G, Klaus Buchner (Ökologisch-Demokratische Partei) and Michèle Rivasi (Europe Écologie)

https://klaus-buchner.eu/wp-content/uploads/2020/06/ICNIRP-report-FINAL-19-JUNE-2020.pdf?fbclid=IwAR2KXrqBWlRabA4vD9hWeneeLab2olDyJO_dE6AEkZ8IWhJWXb8mDH9ORDc

The above report states the following:

1. There have been **massive conflicts of interests for ICNIRP members and the members of the WHO** involved in studying EMF radiation between 1996 and 2006 under the control of Michael Repacholi (page 27).

2. The ICNIRP has a **biased composition**, which is "*still lacking people with a relevant medical background and over-represented by physical scientists, which may not be the wisest composition when your remit is to offer advice on human health and safety to governments around the world*." (page 36).

3. Several ICNIRP-members are, or were, **also members of the International Committee on Electromagnetic Safety (ICES) of the IEEE**. This is an organisation in which many people from the media and telecom industry and from the military are actively and openly involved (page 38).

4. A lot of ICNIRP-scientists have also participated in research work that was **funded, or partly funded, by the telecom industry** (page 39).

5. Lloyd Morgan states "*The International Committee on Non-Ionising Radiation Protection (ICNIRP) are a **private, self-appointed body or NGO** who together with the Advisory Group on Non-ionising Radiation (AGNIR) and Public Health England (PHE), have somehow ended up effectively setting microwave radiation exposure 'safety' standards for the populations of large parts of the world since the 1990s*." Morgan suspects that high-level persons in the government's administration was "***able to have the legislation passed because almost no-one in the government understood what was happening***." (page 40)

6. Paolo Vecchia has stated "*the **ICNIRP guidelines are neither mandatory prescriptions for safety, the "last word" on the issue, nor are they defensive walls for Industry or others**." This statement makes it clear that **the decision to adopt these guidelines into national legislation as "sufficient to protect public health" is political**. The possible misuse by governments of ICNIRP and its guidelines seems to be another key question, that still needs looking into and answering*." (page 41-42)

7. National governments have their own responsibility to protect their citizens, just as the European Commission has, which after all is the 'Guardian of the Treaty'

and therefore should also take the legally binding 'precautionary principle' into account. (page 42)

8. Insurance companies are back tracking from insuring telecoms companies concerning EMF risks: Swiss Reinsurance Company (Swiss Re), classified

"unforeseen consequences of electromagnetic fields" into the highest risk class, together with endocrine disrupting chemicals. "***The ubiquity of electromagnetic fields (EMF) raises concerns about potential implications for human health, in particular with regard to the use of mobile phones, power lines or antennas for broadcasting.*** *Over the last decade, the spread of wireless devices has accelerated enormously. The convergence of mobile phones with computer technology has led to the proliferation of new and emerging technologies. This development has increased exposure to electromagnetic fields, the health impacts of which remain unknown*." (page 44)

9. Steven Weller , Victor Leach and Murray May state "*that radiofrequency electromagnetic radiation is "a booming multi-trillion-dollar industry globally, and **changing current prescribed safety levels to more stringent standards would bring about unfavourable financial consequences and affect industrial and military functions***." (page 45)

Their conclusions are as follows:

1. They question the self-image of the ICNIRP because it is dominated by physical scientists. This may not be the wisest composition when its remit is to offer advice on human health and safety to governments around the world.

2. Even after much criticism from members of the global scientific community, ICNIRP still adheres to the paradigm that the only proven effects (on health) are thermal.

3. It seems that ICNIRP members are either oblivious to, or are ignoring, scientific studies that find possible adverse health effects in the absence of heating.

4. They find that the ICNIRP consists of a "closed circle of like-minded scientists" which has turned it into a "self indulgent science club, with a lack of bio-medical expertise, as well as a lack of scientific expertise in specific risk assessments.".

5. The majority of ICNIRP-scientists have done, or are doing, research partly funded by industry which makes them immediately biased.

6. Certain members of ICNIRP, are simultaneously members of the International Committee on Electromagnetic Safety (ICES) of the US-registered Institute of

Electrical and Electronics Engineers (IEEE) in which many people from the media and telecom industries, as well as from the military, are actively and structurally involved.

7. National governments have a duty of care and protection of their citizens, and therefore should take the legally binding 'precautionary principle' into account.

8. More independent scientific assessment in this area is fully justified. For really independent scientific advice we cannot rely on ICNIRP. National governments should stop funding ICNIRP and create a new, public and fully independent advisory council on non-ionizing radiation. The funds currently allocated to ICNIRP could be used to set up this new organisation.

2.3 Government Funding

Government funding for 5G and satellite technology collated from various sources is as follows:

1. **Mobile operators have paid approximately £1.4 billion to the UK government** for the airway frequencies that they need to operate 5G: https://www.theguardian.com/business/2018/apr/05/uk-mobile-operators-pay-close-to-14bn-for-5g-spectrum - "*The big four operators have secured broadly the same amount of 5G spectrum to use after the auction. Vodafone won 50MHz of spectrum in the 3.4GHz frequency band auctioned paying **£378m**, BT-owned EE won 40Mhz paying **£303m**, Telefónica-owned O2 picked up 40MHz for **£318m**, and Hutchison-owned Three spent **£151m** on 20Mhz. Three UK had already secured a 40Mhz of 5G spectrum prior to the auction*."
2. The Future Telecoms Infrastructure document states:" *The total level of investment required for the national roll out of full fibre is estimated to be in the region of **£30 billion***."
3. The press release for the West Midlands to become the next test bed for 5G states: "*DCMS funding for the project will come from the **£200 million government has assigned to develop 5G technologies** as part of more than **£1bn of investment in next-generation digital infrastructure**, including via the £31bn National Productivity Investment Fund (NPIF)*." (https://www.gov.uk/government/collections/5g-testbeds-and-trials-programme)
4. **£35 million** from the NPIF has been allocated to explore ways to improve mobile communications for rail passengers. This will upgrade the Network Rail test track in Melton Mowbray and install trackside infrastructure along part of the Trans Pennine route and support to the rollout of full-fibre and 5G networks.
5. **£10 million** has been allocated to work with the National Cyber Security Centre to create capabilities where the security of 5G Networks can be tested and proven.

6. Digital Minister Margot James has announced the winners of a **£2.4 million** project with South Korea to explore new 5G experiences for tourists and commuters on public transport.
7. **£6million**, subject to grant funding agreements, for Industrial 5G Testbeds and Trials that will focus on developing and understanding the deployment of 5G in industrial settings starting with manufacturing.
8. The Rural Connected Communities (RCC) Project is funding seven 5G R&D projects in rural areas across the UK and will invest **£30 million** over two years.
9. The 'Click' programme on BBC iPlayer from (02/05/2020) stated that **£2.6 million government funding** has been allocated to **drone and satellite projects**. The latest drones use 5G which means that the government wants to install 5G masts so this technology can be deployed (https://www.qualcomm.com/invention/technologies/lte/advanced-pro/cellular-drone-communication) and (ttps://www.dronezon.com/learn-about-drones-quadcopters/what-is-drone-technology-or-how-does-drone-technology-work/). The latter URL states: "*Nearly all drones have a Ground Station Controller (GSC) or **a smartphone app**, allowing you to fly the drone and to **keep track of the current flight telemetry (UAV range, height, speed, GNSS strength***)."

2.4 Government Strategy

Government strategy is covered in the following document:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/732496/Future_Telecoms_Infrastructure_Review.pdf

as well as the National Planning Policy Framework:
https://www.gov.uk/government/publications/national-planning-policy-framework--2

2.4.1 Financial Reasons

- The government wants the UK to be a **world leader in 5G** and take early advantage of the benefits from this new technology. They have set a target that the majority of the population will be covered by a 5G signal by 2027.
- It wants to harness all the 5G advantages of higher data rates, lower latency, higher energy efficiency and improved performance, mobile technology designed to support multiple applications, from mobile broadband and entertainment services, robotics and logistics (see Figure below).
- It wants the UK to be the "***best place to start and grow digital businesses***."
- They want to '*build fixed and wireless networks that are **fit for the future'***
- They have allocated investment into drone technology which means they want 5G masts deployed regardless of the impact on our health

2.4.2. Planned Types of Deployment

- The government wants to **deploy 5G connectivity across all new housing sites** (300,000 new homes a year over the next few years) with '*future-proofed full fibre connectivity*'
- They plan to deploy **5G in hospitals, health centres and GP surgeries as 'anchor tenants'** so that surrounding communities can access the connectivity via their proximity to these hubs
- They also want to **upgrade schools, libraries and emergency response buildings** to gigabit-capable full fibre connections, i.e. 5G

- They want to **backhaul connectivity for a 5G trial to trains**, which will be used for **fibre connectivity between communities along the route** and also for **enhanced connectivity between the Manchester and Leeds Internet Exchanges**

2.4.3. Low Cost Plans

- The government wants to make the cost of deploying fibre networks **as low as possible** by addressing barriers to deployment, which both increase costs and cause delays;
- Their aim is **to reduce the cost of deploying high-speed electronic communications networks**, so if masts are a cheaper option, they will not want to install underground wired 5G technology if that proves to be more expensive
- They want to strategically re-purpose existing infrastructure to allow full fibre to be rolled out at a fraction of what it would otherwise cost

2.4.4 Attitude toward Regulations

- They want **regulation only where and to the extent it is necessary** to address competition concerns and to ensure that the interests of consumers are safeguarded and *to provide the longer-term stability and predictability that investors need'*
- It has created a '***Barrier Busting Task Force**, whose remit it is to **identify barriers to fixed and mobile network deployment**, and to work with industry, local authorities, **and** others to **overcome them'***
- It sees that "***changes will be necessary in the regulatory and policy environment**, **to incentivise** the large-scale deployment of new networks in rural and urban areas across the UK*."
- The government wants Ofcom to exercise **regulatory forbearance** to incentivise the roll out of full fibre networks by giving the market the **freedom to evolve** and **only regulating if competition concerns clearly emerge – so not other form of regulation!**
- The government wants Ofcom to consider whether their **regulatory approach to existing copper assets needs to change** in light of the switch to fibre networks. **So they want Ofcom to change its regulations because of their agenda.**
- The UK government has used the National Planning Policy Framework (NPPF) to **generate clauses which undermine the autonomy of local planning authorities**. Site specific plans for various masts written by mobile operators for local planning authorities state: "*The support for telecoms and the need not to constrain Operators is laid out in Paragraph 116. Local planning authorities **must determine applications on planning grounds only**. **They should not seek to** prevent competition between different operators, **question the need for an electronic communications system, or set health safeguards different from the International Commission guidelines for public exposure**."*
- We have a central government that is discouraging local authorities from making their own decisions on planning and also targeting our local city councils with funding to incentivise them to authorise access to the local infrastructure for the implementation of 5G, whether we like it or not

2.4.5 Easy Access Plans

- It wants to **support market entry and expansion** by alternative network operators **through easy access to Openreach's ducts and poles**, complemented by access to other utilities' infrastructure (for example, **sewers**)
- The government is **forcing Openreach to give access to its infrastructure (ducts and poles) to implement the 5G connectivity by forcing compliance using Ofcom**
- Where ducts and poles are not available or ineffective, they want other options to enable market entry and expansion by alternative networks, such as dark fibre (un-used fibre optic cable)

- The government wants to **force landlords to enable mobile operators access to their building or land** in order to provide 5G connectivity for their tenants by providing a 'right to entry where a landlord is given notification of an operator's intention to access a property, with a magistrate providing the warrant to entry
- They also want **access to sewer networks to deploy 5G networks** but right now that is being used for business deployment as opposed to residential deployment
- The government, as a major landlord in the UK, **plans to open up its own estate to support the deployment of mobile infrastructure** wherever possible
- The government is **encouraging other public sector landlords** to make their own assets more readily available for 5G deployment

2.4.6 Incentivisation by Government to do the Switch

- The government wants **mass take up of 5G to secure a return on mobile operators' investment which then will justify further roll out across the country**
- They are using a **£67 million voucher scheme to incentivise households, SMEs and local communities** to cover the cost of a fibre connection (£2 million of these have been used suppliers to roll out gigabit-capable connections on entire business parks and in communities)
- Other incentive schemes consist of **minimum volume commitments** between the wholesale provider and internet service providers (ISPs), which could **encourage ISPs to move consumers onto full fibre networks**
- The government is **incentivising local authorities with targeted funding** if they harness public sector connectivity and aggregate private sector demand to build new and extend existing fibre networks i.e. deploy 5G
- To aid the migration of customers to fibre networks, the government **expects that network operators will offer suitable 'entry level' products at prices close to those offered on copper networks**, so that they will accept a fibre based service and be willing to switch.
- The government intends to use the **full range of available levers**, including **funding available through the 5G Testbeds and Trials Programme and Local Full Fibre Networks Programme**, to encourage local areas to use the best practice guidelines to **reduce or eliminate local barriers to deployment**.
- The government wants mobile providers to converge services into bundles so that a customer will have a single tariff for e.g. multiple services such as broadband and pay-TV, with quad-play bundles. In countries where there is a better fibre infrastructure, they are characterised by significant network convergence and the use of fibre networks for fixed, mobile and IPTV services.

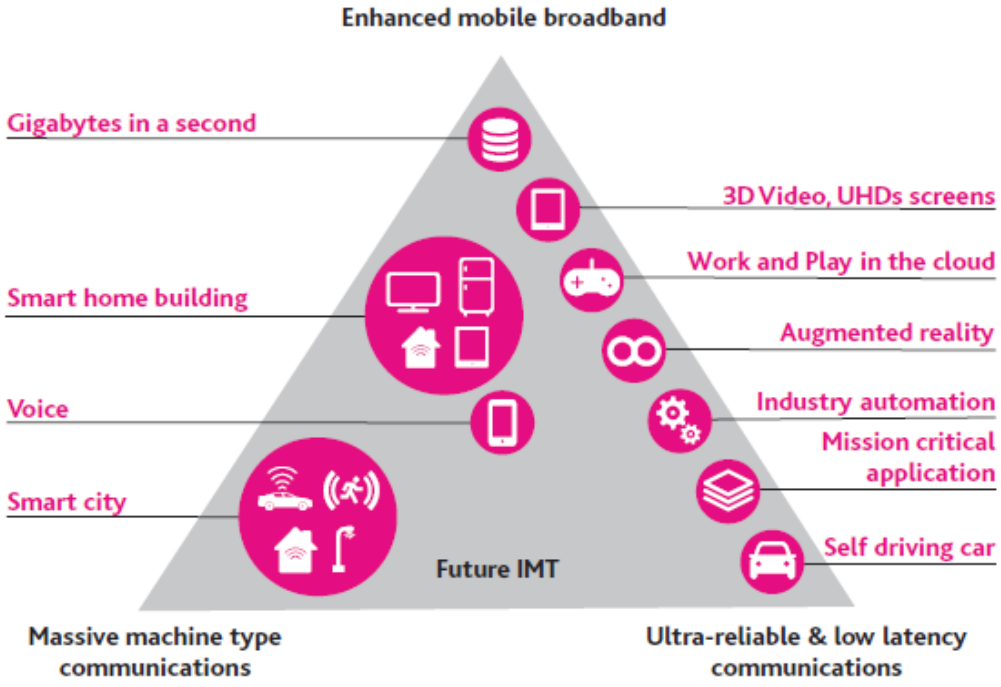
2.4.7 Switch Over Plans from Copper Wires to Fibres

- The government wants customers to **switch to new fibre networks** ('switchover') and for Openreach to **retire the legacy copper networks** ('switch-off').They envisage this will happen by 2030, but the timing will ultimately be dependent on the pace of fibre roll out and customer take-up of fibre products.
- They are aware that **some customers who have no broadband** and only use a landline **may be disadvantaged by providing only a full fibre network**, and say that such customers should not be disadvantaged by the switch to fibre.
- Some business applications dependent on copper network connectivity would need to be re-planned.
- The government says that the **switchover from copper to fibre should be transparent**, so that customers have the information they need to make informed choices and clearly signalled via notice periods so operators have certainty – **this is not happening as customers have not been informed** and most will not have the bandwidth to read 90 page documents such as that above.

- The government will expect switchover to start when a significant proportion of the population has taken-up new fibre services, which means **we need to vote with our feet**.
- A **switch over from copper to fibre would mean that certain copper-based services that would not work on fibre networks (including care, home and security alarms). The public are currently unaware of this**!

2.4.8 Other Key Points We Need to Understand

- The government realises that early 5G launches will likely focus on enhanced mobile broadband services to increase the capacity and capabilities of existing networks, subject to the availability of consumer handsets. **Therefore the less we use and upgrade our handsets to 5G and the less we upgrade our connectivity to faster broadband, the less likely that 5G will be launched across more sites in the UK**, as it will not be commercially viable for the government or the mobile virtual network operators (MNO).
- The government wants to **de-risk deployment of 5G by stimulating the growth of new use 5G test bed cases**. Therefore it is not open to any scientific data that might indicate that this technology is unsafe to mankind or other species.
- There is a precedent to ask for **underground wired works** in all cities and towns as **Northumberland County Council and National Parks England have worked with mobile operators on a solution** with most of the build now going underground. Superfast broadband was secured for 125 premises in a very rural area.



Source: International Telecommunications Union (2015), 'IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond'

.2.5 Ubiquitous Negative Effects of EMR

The scientific data from Entrez Pubmed (extracted in Tables 2 & 3) shows that there are loads of papers showing peer reviewed scientific evidence across multiple species for **negative biological health effects due to low level EMR**. Table 1 below which is an extract from Tables 2 &3, shows the following:

1. Multiple species are negatively affected by low level EMR as a whole, not just human
2. Multiple organs are negatively affected in any given species by low level EMR
3. Multiple biological pathways are negatively impacted by low level EMR as seen by the type of effects caused
4. Multiple negative biological effects are seen (nerve, kidney, bladder, testis damage, blood brain damage and cognitive impairment) in a single species, (e.g. rat) when a single level of EMR radiation is applied (e.g. 900 MHz)

Table 1: Multiple Species Show Various Negative Biological Responses to EMR

Frequency / Hz	Effect	Species	Paper	Type of Effect
1.5 mT at 50 Hz	Changes in the levels of copper in serum samples, femur, and kidney	Guinea pigs	Erdem et al 2018	Trace element disturbances
1.5 mT at 50 Hz	Changes in levels of magnesium in brain, kidney, and lung	Guinea pigs	Erdem et al 2018	Trace element disturbances
6 mT at 60 Hz	continuous exposure of HeLa and primary IMR-90 fibroblasts promoted cell proliferation and was directly correlated with EMR strength and exposure time	Human	Song et al 2018	Cancer cell proliferation
0.8 mT at 60 Hz	production and expression of nitric oxide and pro-inflammatory cytokines, TNF-α, IL-1β, and IL-6, were increased	Mouse cell line	Kim et al 2017	Amplified inflammatory immune response
0.8 mT at 60 Hz	Translocation of NF-κB (nuclear factor kappa B), molecules that act downstream of the pro-inflammatory cytokines, were increased to the nucleus	Mouse cell line	Kim et al 2017	Amplified inflammatory immune response
0.8 mT at 60 Hz	elevated activation of nuclear factor of activated T cells (NFAT) 2, as well as positively affected the influx of calcium	Mouse cell line	Kim et al 2017	Amplified inflammatory immune response
1 and 100 μT at 50 Hz	expression levels of RORα and c-Maf were significantly downregulated	Rat	Mahaki H et al 2019	Immune response markers downregulated in rat spleen
1.5 mT at 50 Hz	Thickening of glomerular basement membranes in kidney	Rat	Tunik et al 2013	Kidney damage
1.5 mT at 50 Hz	Decreased expression levels of E-cadherin	Rat	Tunik et al 2013	Kidney damage

10.021 µW/cm2 at 925 MHz.	Significant impairment in Motor Screening Task (MOT; p = .03) and Spatial Working Memory (SWM) task (p = .04) was identified	Human	Meo et al 2018	Impairment of spatial working memory, delayed motor skills and attention in adolescents
100 µT at 50 Hz	expression of STAT6 was significantly decreased	Rat	Mahaki H et al 2019	Immune response markers downregulated in rat spleen
1800 MHz	decreases in relative heart weight and right ventricle wall thickness	Chicken	Pawlak et al 2018	Developmental damage and stress
1800 MHz	significant increase in plasma corticosterone level and decrease in fat and glycogen in the liver	Chicken	Pawlak et al 2018	Developmental damage and stress
1800 MHz at 6.8 ± 0.1 V/m and 0.06 W/kg	caspase-3 and p38MAPK gene expression were significantly upregulated in coular tissue	Rat	Eker et al 2018	Ocular cellular damage
2.0 mT at 60 Hz	number of apoptotic-like cells significantly increased	Moth larvae	Valadez-Lira et al 2017	Immune system adverse effects
2.0 mT at 60 Hz	hemolymph total protein and hemocyte cells were reduced	Moth larvae	Valadez-Lira et al 2017	Immune system adverse effects
2.0 mT at 60 Hz	higher number of oenocytoids in the 72-h-exposed larvae (28.6-fold increase)	Moth larvae	Valadez-Lira et al 2017	Immune system adverse effects
2.0 mT at 60 Hz	antimicrobial peptides cecropin, lysozyme, gallerimycin, and pgrp were downregulated	Moth larvae	Valadez-Lira et al 2017	Immune system adverse effects
2.0 mT at 60 Hz	attacin and defensin were upregulated	Moth larvae	Valadez-Lira et al 2017	Immune system adverse effects
2.1 GHz	significant increase in nitric oxide levels and decrease of β-AR responsiveness in ventricular myocytes	Rat	Olgar et al 2015	Cardiac effect
2.4 GHz	MDA levels significantly higher whereas SOD and GSH-Px activities were significantly lower	Human embyonic kidney cells	Pastacı Özsobacı et al 2018	Oxidative stress and apoptosis
2.45 GHz	Serum IL-6 and CRP levels significantly different in the study group compared to the control group (p < .05)	Rat	Bilgici et al 2018	Increased inflammation and testicular damage
2.45 GHz	Histopathological evaluation of testicular tissue revealed a significant difference in necrosis and spermatogenesis	Rat	Bilgici et al 2018	Increased inflammation and testicular damage
200 kV m-1	induced a decrease of testosterone , sperm quantity and acrosin activity in the male offspring	Rat	Yang et al 2018	Reproductive toxicity
2100 MHz	Deterioration in the brush border of renal tubules	Rat	Bedir et al 2018	Oxidative stress-mediated acute renal injury

2100 MHz	renal MDA levels increased, and renal GSH levels decreased	Rat	Bedir et al 2018	Oxidative stress-mediated acute renal injury
3 mT at 50 Hz	TCA cycle enzyme, fumarase was found with decreased expression	Nematode worm	Sun et al 2018	Oxidative stress
3 mT at 50 Hz	elevated concentrations of arachidonic acid (ArA) and prostaglandin E2(PGE2) and increased expression of prostaglandin E2 synthase (PGES-2)	Nematode worm	Sun et al 2018	Oxidative stress
400 MHz - 3 GHz	many ipsilateral tumours found, the higher the exposure (ipsilateral vs contralateral), the longer the cumulative exposure (hours of exposure) and the longer the latency (beyond 10 years); the greater the risk	Human	Pareja-Peña et al 2020	Statistically significant brain tumour induction
8 mT at 50 and 120 Hz	alterations in the synthesis and secretion of oestradiol-17β (E2)	Pigs	Koziorowska et al 2018	Altered oestrogen hormone secretion
835 MHz at 4.0 W/kg	Expression levels of LC3B-II protein and p62, crucial autophagic regulatory proteins, changed in hippocampus	Mice	Kim et al 2018	Autophagy (stress response)
835 MHz at 4.0 W/kg	increase in the number of autophagosomes and autolysosomes in the hippocampal neurons	Mice	Kim et al 2018	Autophagy (stress response)
835 MHz at 4.0 W/kg	myelin sheath damage and hyperactivity-like behaviour	Mice	Kim et al 2017	Nerve damage and hyperactivity
900 MHz	marked thickening in the epineurium of sciatic nerves	Rat	Kerimoğlu et al 2018	Sciatic nerve damage
900 MHz	MDA, SOD and CAT levels were higher	Rat	Kerimoğlu et al 2018	Sciatic nerve damage
900 MHz	increase in the number of TUNEL (+) cells	Rat	Kerimoğlu et al 2018	Sciatic nerve damage
900 MHz	haemorrhage in glomerulus, vacuolization and irregularity in the proximal and distal tubular epithelium, diffuse glomerular degeneration and edema, occasional degeneration in Bowman capsules, haemorrhage in the medullary region, disturbed nucleus location and morphology, and tubular edema in the cortex	Rat	Okatan et al 2018	Kidney Damage
900 MHz	Tissue malondialdehyde increased	Rat	Türedi et al 2017	Oxidative stress and Pathological damage to kidney and bladder

900 MHz	Catalase and glutathione levels decreased	Rat	Türedi et al 2017	Oxidative stress and Pathological damage to kidney and bladder
900 MHz	dilatation and vacuolization in the distal and proximal tubules, degeneration in glomeruli and an increase in cells tending to apoptosis were observed in kidney	Rat	Türedi et al 2017	Oxidative stress and Pathological damage to kidney and bladder
900 MHz	degeneration in the transitional epithelium and stromal irregularity and an increase in cells tending to apoptosis in bladder	Rat	Türedi et al 2017	Oxidative stress and Pathological damage to kidney and bladder
900 MHz, 1 mW/cm^2	induced the expression of mkp-1, resulting in ERK dephosphorylation	Rat	Tang et al 2015	Blood-brain barrier damage and cognitive impairment
Mobile EMR (800 MHz - 2.6GHz)	significant decrease in immunoglobulin levels (IgA, IgE, IgM, and IgG); total leukocyte, lymphocyte, eosinophil and basophil counts	Rat	El-Gohary et al 2017	Compromised immune system effects
Mobile EMR (800 MHz - 2.6GHz)	significant increase in neutrophil and monocyte counts	Rat	El-Gohary et al 2017	Compromised immune system effects
mobile GSM band at 2600 MHz	dilatation of sinusitis in liver was determined to be higher	Rat	Postaci et al 2018	Oxidative stress
mobile GSM band at 2600 MHz	increase in liver malondialdehyde level	Rat	Postaci et al 2018	Oxidative stress
mobile GSM band at 900 MHz	significantly reduced the hatching ratio	Bee	Odemer et al 2019	Developmental delay
mobile GSM band at 900 MHz	increases in testicular proteins	Rat	Sepehrimanesh et al 2017	Testicular cancer markers increased by EMRs

Barnes & Greenebaum (2020) [25] state: *"ICNIRP have not found sufficient evidence to include health effects of long-term exposures at lower levels. However, over the last 20 years the* ***evidence has become extremely strong that weaker EMR over the whole range for frequencies from static through millimeter waves can modify biological processes.*** *There is now solid experimental evidence and supporting theory showing that weak fields, especially but not exclusively at low frequencies, can modify reactive free radical concentrations and that changes in radical concentration and that of other signaling molecules, such as hydrogen peroxide and* ***calcium, can modify biological processes."***

Negative non-thermal biological effects from EMRs seen in many peer reviewed scientific articles reviewed by Pall (2018) [1] are as follows:

1. **Lowered fertility**, including tissue re-modelling changes in the testis, lowered sperm count and lowered motility and other measures of lowered sperm quality, lowered female fertility including ovarian re-modelling, oocyte (follicle) loss, lowered oestrogen, progesterone and testosterone levels (that is sex hormone levels), increased spontaneous abortion incidence, lowered libido (25 articles).
2. **Neurological/neuropsychiatric effects** including sleep disturbance/insomnia; fatigue/tiredness; headache; depression/depressive symptoms; lack of concentration/attention/cognitive dysfunction; dizziness/vertigo; memory changes; restlessness/tension/anxiety/stress/agitation; irritability (29 articles).
3. **Effects on cellular DNA including single strand and double strand breaks in cellular DNA** and on oxidized bases in cellular DNA; also evidence for chromosomal mutations produced by double strand DNA breaks. These produce all of the important type of mutations, as described at the DNA level that have roles in cancer causation and in human whole organism mutation (24 articles).
4. **Apoptosis/cell death** (an important process in production of neurodegenerative diseases that is also important in producing infertility responses) (15 articles).
5. **Oxidative stress/free radical damage** (important mechanisms involved in almost all chronic diseases; direct cause of cellular DNA damage) (25 articles).
6. Endocrine, that is **hormonal effects**; Includes changes in non-steroid and also steroid hormones (15 articles).
7. **Increased intracellular calcium levels**, thought to be the cause in all other effects (16 articles).
8. **Cancer including initiation, promotion and progressio**n, further including tumour progression, tissue invasion and metastasis) (39 articles)
9. **Cardiac effects**, include **tachycardia, arrhythmia and bradycardia** (with bradycardia typically reported after long times of exposures). Some recent studies have also reported heart palpitations. Arrhythmias, especially when they are associated with either bradycardia or severe tachycardia, are often associated with sudden cardiac death. Sudden cardiac death causes over 5% of the total mortality in technologically advanced countries, so this could be a major source of EMR-caused fatality. (9 articles)

Tables 2 & 3 list other and more recent low level non-thermal EMR biological effects which has been found by searching Entrez Pubmed (https://www.ncbi.nlm.nih.gov/pubmed/). These are just a **fraction** of the non-thermal EMR biological effects that there are in the literature as some of the articles go back as far as the 1970's. Wilke (2018) [19]

Pall (2018) [1] also states that there are 26 different studies that have shown that EMR produces diverse non-thermal effects through **voltage gated calcium channels** (VGCCs) in our cells and produce negative biological effects such as oxidative stress, cellular DNA damage and increased calcium signalling. The voltage sensors of the VGCCs are very sensitive to low intensity EMR causing increases in intracellular calcium which has downstream very large pathophysiological effects and major cell damage. The **voltage sensor** of the VGCC is the predominant target of the EMR radiation and as such is currently ignored by the current safety guidelines of the ICNIRP. The **effects of VGCCs are also backed up by & Doyon PR et al, (2017) [8] Herbert MR & Sage C (2013). [15]** Pall (2018) [1] quotes: *The failure of the "safety guidelines" to discuss the relevant physics of the voltage sensor means that the physics underlying the "safety guidelines" is* ***deeply flawed.*****'**

Much of the scientific evidence is pointing to deep concern regarding the **dangers of 5G to our human population** as well as even greater danger to **delicate smaller mammals, birds and insects** which "*will be heavily impacted because of their large surface to volume ratios. The same thing will be true of plants where even large trees have their leaves and reproductive organs highly exposed*." Pall 2019 [2] This is because the type of radiation that 5G consists of, is the type where due to its "***low penetration and very high energy deposition per unit distance****, this can lead to generation of high levels of free radicals in a short distance which in turn increases the risk of* ***skin cancer***." Mortazavi & Mehdizadeh (2019) [25].

Ziskin, M. (2013) [4] states: "*The resulting "millimeter wave signal" is transmitted through the cutaneous nerve through the dorsal root ganglion into the spinal cord [Radzievsky et al.,2001]. At the first synapse in the spinal cord, there is a release of* ***endogenous opioids****. The release of*

*endogenous opioids occurs in at least two other spots in the brain. The subsequent release of endogenous opioids into the blood stream spreads these chemicals throughout the body, and certainly is adequate for explaining why pain relief can result from MMW exposures. The involvement of endogenous opioids in MMW therapy is verified by the fact that the beneficial effect of MMW therapy is completely abolished upon the administration of naloxone, a general opioid inhibitor [Radzievsky et al., 2000, 2008]**. Opioids are also known to have wide-ranging effects on various systems in the body including the immune system.** The transmission of the MMW signal through the cutaneous nerve is verified by the fact that the beneficial effect of MMW therapy is completely abolished by severing the nerve leading to the spinal cord".*

Treatments that are therapeutic in moderation are harmful in an overdose situation. A **constant release of opioids, stimulation of the immune system and cell growth in conjunction with DNA mutations (e.g. cancer) as a result of continuous 5G exposure, might see the UK population significantly harmed.**

2.6 Negative Immune Effects of EMR

A recent BBC news article (see below link) described Dr Simon Clark, associate professor of microbiology at Reading University as saying, ""*The idea that 5G lowers your immune system doesn't stand up to scrutiny.*"

https://www.bbc.co.uk/news/52168096

However, multiple areas of electromagnetic systems negatively impact the immune system including frequencies which are at much lower levels than 5G and both ELF-EMR and RF-EMR evidence exists in the literature. Below are listed four peer reviewed scientific papers below to illustrate this in Table 2:

Table 2: Negative Immune Responses as result of EMR radiation

Negative Effect by EMR radiation	Paper	Findings and actions	Species
Immune system suppressing effects by EMRs	Doyon PR, Johansson O. Med Hypotheses. 2017 Sep;106:71-87. **Electromagnetic fields may act via calcineurin inhibition to suppress immunity, thereby increasing risk for opportunistic infection: Conceivable mechanisms of action**.	...**a number of scientific studies, have shown that electromagnetic field exposures may indeed produce the same effect: a weakened immune system leading to an increase in the same or similar opportunistic infections: i.e., fungal, viral, atypical bacterial, and parasitic infections.** Furthermore, numerous research studies have shown that **man-made electromagnetic fields have the potential to open voltage-gated calcium channels, which can in turn produce a pathological increase of intracellular calcium, leading downstream to the pathological production of a series of reactive oxygen species**. Exposures to electromagnetic fields have the potential to **inhibit immune system response by means of an eventual pathological increase in the influx of calcium into the cytoplasm of the cell, which induces a pathological production of reactive oxygen species, which in turn can have an inhibitory effect on calcineurin.** Calcineurin inhibition leads to immunosuppression, which in turn leads to a **weakened immune system and an increase in opportunistic infection.**	Human

Decrease in adaptive immune response in rats by EMRs	Mahaki H, Tanzadehpanah H, Jabarivasal N, Sardanian K, Zamani A. Electromagn Biol Med. 2019;38(1):84-95. **A review on the effects of extremely low frequency electromagnetic field (ELF-EMR) on cytokines of innate and adaptive immunity.**	Physical and biological parameters of ELF-EMR can interact with each other to create beneficial or **harmful effect on the immune cell responses by interfering with the inflammatory or anti-inflammatory cytokines.** ...Furthermore, **long-term (2-24 h/d up to 8 years) exposure to low-density ELF-EMR may cause a decrease in adaptive immune response**, especially in Th1 subset.	Rat
Adaptive immune response effects	Valadez-Lira JA, Medina-Chavez NO, Orozco-Flores AA, Heredia-Rojas JA, Rodriguez-de la Fuente AO, Gomez-Flores R, Alcocer-Gonzalez JM, Tamez-Guerra P. Environ Entomol. 2017 Apr 1;46(2):376-382. **Alterations of Immune Parameters on Trichoplusia ni (Lepidoptera: Noctuidae) Larvae Exposed to Extremely Low-Frequency Electromagnetic Fields.**	Trichoplusia ni Hübner **larvae were exposed for 24, 48, or 72 h to ELF-EMRs (60 Hz and 2.0 mT) to assess effects on immune response parameters and fertility**. Trichoplusia ni Hübner life cycle and fertility were not affected by 24-h exposure. However, the **number of apoptotic-like cells and cellular immune response significantly increased** ($P < 0.01$) after 72-h exposure (2- and 1.1-fold, respectively), whereas **hemolymph total protein and hemocyte cells were reduced** ($P < 0.01$; 16 and 50%, respectively) after 48-h exposure. Hemocyte cell type analysis resulted in significantly ($P < 0.01$) higher granulocytes number in the unexposed (2-fold increase) and **oenocytoids in the 72-h-exposed larvae (28.6-fold increase)**. Quantitative retrotranscription (RT-qPCR) showed that **after 72-h ELF-EMR exposure, the antimicrobial peptides cecropin, lysozyme, gallerimycin, and pgrp were downregulated by 24,866.0, 2.69-, 119.1-, and 1.45-fold, respectively, whereas attacin and defensin were upregulated by 1.59- and 1.85-fold, respectively.**	Larvae (Moth)
Compromised immune system effects (e.g. decreases in immunoglobulins) by EMRs in rats	Ola Ahmed El-Gohary, Mona Abdel-Azeem Said. Canadian Journal of Physiology and Pharmacology, 2017, Vol. 95, No. 2 : pp. 151-156 **Effect of electromagnetic waves from mobile phone on immune status of male rats: possible protective role of vitamin D**	**Studied the effect of electromagnetic field (EMR) emitted from a mobile phone on the immune system in rats and the possible protective role of vitamin D**. Rats were randomly divided into six groups: Group I: control group; Group II: received vitamin D (1000 IU/kg/day) orally; Group III: exposed to EMR 1 h/day; Group IV: exposed to EMR 2 h/day; Group V: exposed to EMR 1 h/day and received vitamin D (1000 IU/kg/day); Group VI: exposed to EMR 2 h/day and received vitamin D (1000 IU/kg/day). After 30 days of exposure time, 1 h/day **EMR exposure resulted in significant decrease in immunoglobulin levels (IgA, IgE, IgM, and IgG); total leukocyte, lymphocyte, eosinophil and basophil counts; and a significant increase in neutrophil and monocyte counts**. These changes were more increased in the group exposed to 2 h/day EMR. **Vitamin D supplementation in EMR-exposed rats reversed these results** when compared with EMR-exposed groups. **Exposure to mobile phone radiation compromises the immune system of rats, and vitamin D appears to have a protective effect.**	Rat

Viral infections occur as a result of a dampened or inadequate immune system which is unable to fight the invader. Our ecosystem contains many natural anti-viral agents (e.g. neem) (Tiwari et al. (2010) [31] which are effective against viruses that occur naturally. The ability of human beings to fight highly virulent strains depends on their inherent, pre-existing immune system.

The state of that immune system is likely to be **negatively impacted by electromagnetic radiation** as seen by multiple papers citing negative immune biological responses to EMRs in Table 2:

1. Doyon & Johanssen (2017) suggest the following mechanism of action: EMR causes a pathological increase in the influx of calcium into the cytoplasm of the cell, which induces a pathological production of reactive oxygen species, which in turn can have an inhibitory effect on calcineurin. Calcineurin inhibition leads to immunosuppression, which in turn leads to a **weakened immune system and an increase in opportunistic infection.**
2. Mahaki *et al*. 2019 find that long-term (2-24 h/d up to 8 years) exposure to low-density EMR may cause **a decrease in adaptive immune response** in rats
3. Valedez-Lira *et al*. 2017 found that the antimicrobial peptides **cecropin, lysozyme, gallerimycin, and pgrp were downregulated** by EMR exposure in moth larvae
4. El-Gohary *et al*. 2017 found that EMR exposure resulted in **significant decrease in immunoglobulin levels** (IgA, IgE, IgM, and IgG**); total leukocyte, lymphocyte, eosinophil and basophil counts** in rats

Therefore, in the light of an external environment which has a greater density of EMR due to a 5G roll out, this is likely to cause an environment of dirty electricity, which increases the likelihood for the exposed human population to have:

1. a weakened immune system due to calcineurin inhibition which in turn causes immunosuppression
2. an increase in opportunistic infection as a result of a decrease in adaptive immune responses
3. downregulation in the expression of antimicrobial peptides
4. decreases in antibodies (immunoglobulins) and cells that defend the body against infection like leukocytes, lymphocytes, eosinopils and basophils

Belyaev *et al*. in the 2016 EUROPAEM EMR Guidelines [(18)] state: *"On the one hand, there is strong evidence that long-term exposure to certain EMRs is a risk factor for diseases such as certain cancers, Alzheimer's disease, and male infertility. …We recommend treating electromagnetic hypersensitivity (EHS) clinically as part of the group of chronic multisystem illnesses (CMI), but **still recognizing that the underlying cause remains the environment**. In the beginning, EHS symptoms occur only occasionally, but over time they may increase in frequency and severity. Common EHS symptoms include headaches, concentration difficulties, sleep problems, depression, a lack of energy, fatigue, and **flu-like symptoms**.*

During pandemics EMR in the environment is very likely to exacerbate the situation with respect to enabling our human population to fight infections effectively, for the above four listed biological reasons. The government however is misleading the public by saying that there are no negative immune effects because in actual fact, they have not done any safety testing of 5G, so are not in a position to make such statements.

There is no safety testing data on 5G which has already been rolled out in the UK, and so it becomes even more urgent to ensure that hospitals which house infected individuals are free of electromagnetic radiation, so that both patients and NHS staff are given the best chance to fight infections in electromagnetically clean environments.

2.7 Evidence for Sinusoidal Dose Response Curves and Low Intensity EMR Effects

Pall (2019) [(2)] states we now have available to us, two translated CIA documents (Zalyobokskaya NP, 1977) [(27)] and (Levedeva NN, 2000 [(28)] which show the following:

1. **Biological effects by low intensity continuous millimeter wave radiation which are 20 times deeper** than what is claimed by industry, occur to the internal organs of rodents including **heart, kidney, liver, spleen and bone marrow**. There are even more severe effects on the **skin** of the rodents (Zalyobokskaya NP, 1977) [(27)]

2. The biological effects seen by Zalyobokskaya NP, 1977[27] are **modest at first that can be reversible with cessation of exposure** but become **much more severe with increasing times of exposure.**
3. Levedeva NN, 2000 [28] did EEG study where electrical activity in the brain was being monitored. Here for the low intensity millimeter continuous wave EMR exposure to have effects, it had to penetrate the hair, skin, skull and meninges surrounding the brain. Human effects are found at least 20 times deeper than the industry claims is possible.

This is also seen by scanning the literature:

a) The findings of Zalyobokskaya NP, 1977 are matches searches of the literature in Tables 2 & 3 and is supports the fact that the effects of low level EMR radiation are seen across **multiple organs** (see above, page 16, point 2).
b) Lazlo et al 2018 (Table 3) show that after a 1-wk-long adaptation period, EMR of 10 μT at 50 Hz applied to turkeys for 3 weeks results in a decreased NE-activated β-adrenoceptor function in treated birds in a time-dependent manner, but during a 5 week regeneration period, the decreased NE-dependent β-adrenoceptor function could be **compensated** by the homeostatic complex. This supports the **reversibility of effects** seen by Zalyobokskaya NP, 1977[27].
c) Mortazavi & Mehdizadeh (2019) (Table 3) replot data from Morgan et al (2015) [26] and show evidence which supports a **nonlinear J-shaped dose-response relationship for the carcinogenesis of non-ionizing RF-EMR from mobile phone radiation**. This also supports the cumulative effect of EMR radiation seen by Zalyobokskaya NP (1977) [27] and agrees with Pall's statement that the ICNIRP are ignoring dose-responsive data – Pall (2018) [1].

2.8 No Safety Testing Data is Available for 5G

Wireless carriers have conceded to U.S. Senator Richard Blumenthal that they are **not aware of any independent scientific studies on the safety of 5G technologies**– see reference 13 and link :https://www.youtube.com/watch?v=hsil3VQE5K4

This means that the current situation in the United Kingdom is a similar **violation of Human Rights** as was tabled to the United Nations Human Rights Council in early 2019 for Australia by S.J. Toneguzzo. See below UN NGO document link:

https://www.radiationresearch.org/wp-content/uploads/2019/03/pace-UN-Human-Rights-Council-5G-statement.pdf

The **deployment of 5G without safety testing in the UK violates over 15 international agreements**, treaties and recommendations, including article 7 of the International Covenant on Civil and Political Rights, which derives from the Nuremberg Code of 1947, i.e. "*No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment. In particular,* ***no one shall be subjected without his free consent to medical or scientific experimentation****."*

(see below document link):
https://treaties.un.org/doc/publication/unts/volume%20999/volume-999-i-14668-english.pdf

It **also violates the Declaration of Helsinki of 1964** and its several revisions, as well as other international guidelines that have been translated into national laws in various countries, because it "*is* ***the duty of physicians*** *who are involved in medical research* ***to protect the life, health****, dignity,*

integrity, right to self-determination, privacy, and confidentiality of personal information of research subjects." (Principle 9, page 1 of below document)

https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/

But Public Health England and the UK government have ignored the overwhelming amount of scientific literature that points to EMR which damages rather protects the health of the UK population and its ecosystem.

The above mentioned UN NGO document provides clear parallels between the tobacco industry strategy and the regulatory and research capture by the wireless industry today.

Belyaev *et al*. in the 2016 EUROPAEM EMR Guidelines [18] state: "*New wireless technologies and applications have been introduced **without any certainty about their health effects, raising new challenges for medicine and society**. For instance, the issue of so-called non-thermal effects and potential long-term effects of low-dose exposure were scarcely investigated prior to the introduction of these technologies. Common electromagnetic field or EMR sources: Radio-frequency radiation (RF) (3 MHz to 300 GHz) is emitted from radio and TV broadcast antennas, Wi-Fi access points, routers, and clients (e.g. smartphones, tablets), cordless and mobile phones including their base stations, and Bluetooth devices. Extremely low frequency electric (ELF EF) and magnetic fields (ELF MF) (3 Hz to 3 kHz) are emitted from electrical wiring, lamps, and appliances. Very low frequency electric (VLF EF) and magnetic fields (VLF MF) (3 kHz to 3 MHz) are emitted, due to harmonic voltage and current distortions, from electrical wiring, lamps (e.g. compact fluorescent lamps), and electronic devices.*

2.9 The Need for Change in Understanding of EMR harm

Value for money should not be at the cost of human health. The government and regulatory bodies (PHE, HPA, AGNIR, NRPB and planning committees) all need to realise that a **large amount of scientific data** points to **very real negative biological responses**, as a result of **long term EMR exposure**.

The UK population needs access to digital services but **not at the expense of continuous harmful EMR exposure**.

Digital connectivity is still viable with protective measures by using **fibre optic wired technology** for our homes, hospitals, workplaces and schools - see Sage & Burgio (2018) [4] which states: "*Symptoms of retarded memory, learning, cognition, attention, and behavioral problems have been reported in numerous studies and are similarly manifested in autism and attention deficit hyperactivity disorders, as a result of EMR and RFR exposures where both epigenetic drivers and genetic (DNA) damage are likely contributors. **Technology benefits can be realized by adopting wired devices for education to avoid health risk** and promote academic achievement.*"

Wilke (2018) [19] analysed more than 100 scientific articles on 2.45 GHz radiation (level used for Wi-Fi), and found associated **adverse changes** in most of these studies compared to the control groups at levels below the safety guidelines of the ICNIRP. She states: "***Wired solutions should be given preference**. Current exposure limits and SAR values do not protect from health risks associated with Wi-Fi radiation. The adverse effects on learning, attention, and behavior serve as a basis for educational institutions of all age groups to forgo the use of Wi-Fi applications. Due to cytotoxic effects**, **Wi-Fi technologies are not suitable for hospitals and telemedicine**. **Wi-Fi technologies should not be used in bedrooms, work spaces, common lounges, hospital rooms, lecture halls, classrooms, and public transport.** The possible risks associated with Wi-Fi radiation could be avoided by testing alternative technologies at other frequency bands like **optical VLC/Li-Fi technologies** (visible light communication). When Wi-Fi cannot be avoided as a transition solution,*

the ALARA principle must be applied: ***no continuous transmission****, instead* ***Wi-Fi networks that can be turned off and feature dynamic power management*****."**

Precaution and appropriate risk management are not just about physical health, but also an issue of economics. Both matters need to be considered in determining the public benefit and hence the national interest. The economy will also be affected if large numbers of our population are sick due to long term EMR exposure and a sick population will cause NHS costs soar, which will in effect, **damage the economy**, thereby delivering the opposite of value for money. Keeping the **population healthy for longer periods of time**, enables the population to give longer periods of service in work, and thereby boosts the economy.

Democratic freedom in this country needs to be safeguarded, so that the policy of unlimited economic freedom is replaced by planned economic intervention of the state. Unrestrained capitalism needs to give way to economic interventionism **for the wellbeing of the public**. The economic freedom and self-regulation that has been accorded to technology firms by this government should be **balanced with the need to protect the interests, health and well-being of the UK population**. (See below link by Prof Tom Butler)

https://www.radiationresearch.org/wp-content/uploads/2019/10/On-the-Clear-Evidence-of-the-Risks-to-Children-from-Smartphone-and-WiFi-Radio-Frequency-Radiation-Final-2019.pdf

Belyaev *et al*. in the 2016 EUROPAEM EMR Guidelines [18] state the following with regard to the treating electro hypersensitivity: *A comprehensive medical history, which should include all symptoms and their occurrences in spatial and temporal terms and in the context of EMR exposures, is the key to making the diagnosis. The primary method of treatment should mainly focus on the* ***prevention or reduction of EMR exposure, that is, reducing or eliminating all sources of high EMR exposure at home and at the workplace****. The reduction of EMR exposure should also be extended to public spaces such as* ***schools, hospitals, public transport, and libraries*** *to enable persons with EHS an unhindered use (accessibility measure). If a detrimental EMR exposure is reduced sufficiently, the body has a chance to recover and EHS symptoms will be reduced or even disappear. Many examples have shown that such measures can prove effective…* ***Anything that supports homeostasis will increase a person's resilience against disease and thus against the adverse effects of EMR exposure.*** *There is increasing evidence that EMR exposure has a major impact on the oxidative and nitrosative regulation capacity in affected individuals*."

Di Ciaula A (2018) [9] state that "*preliminary observations showed that millimeter waves (MMW) increase skin temperature, alter gene expression, promote cellular proliferation and synthesis of proteins linked with oxidative stress, inflammatory and metabolic processes, could generate ocular damages, affect neuro-muscular dynamics. …available findings seem sufficient to demonstrate the existence of biomedical effects,* ***to invoke the precautionary principle, to define exposed subjects as potentially vulnerable and to revise existing limits***."

Broadband and mobile device take up enables consumers and businesses to gain access to communications, services and mechanisms of purchasing and selling that was previously unavailable to them. This does not mean that they should all be switched over to, as an only mechanism of communication, purchasing and selling. **The public should be entitled to determine how they choose to connect with or not connect with digital media**, particularly 5G, considering the safety testing of this emerging technology is yet to be done (see reference 11 below). Not all human beings choose to exist continuously connected with digital media, nor do they want to be subjected to untested, potentially harmful 5G. Ethical judgements used in the design of such technology needs to be **transparent to the public, and we need a set of global principles that shape the norms and standards** that shape the emergence of 5G roll out. This has yet to be done.

Naren et al (2020) [24] state: "*Different countries have different regulations to limit the radiation density levels caused by these devices. The radiation absorbed by an individual depends on various factors such as* ***the devices they use, the proximity of use, the type of antenna, the relative orientation***

***of the antenna on the device**, and many more. Several standards exist which have tried to quantify the radiation levels and come up with safe limits of EMR absorption to prevent human harm." We need to ensure that we use the standards that **specify safe levels of radiation based on the recognition of both thermal as well as non-thermal negative biological effects of EMR**."*

The UK is using a standard from the ICNIRP which **only recognises thermal negative biological effects**. This means that not only has there **not been any safety testing for 5G roll out**, but the standards currently used in this country are **inadequate** as they only recognise a small fraction of the negative biological effects caused by EMR. This needs to be **corrected immediately**, and we need to recognise the standards set by the medical bodies such as the BB, BioInitiative, and AMA Standards. These limits have been arrived at after extensive scientific research of thermal, non-thermal, chronic exposure, and biological effects carried out by health experts from across the world. On comparing these limits with those prescribed by the ICNIRP, it can be seen that the limits prescribed by the medical bodies are **several orders of magnitude lower** than those prescribed by the ICNIRP. Therefore, a clear understanding of the differences between these limits, and an **assessment of the current exposure levels** in accordance with both kinds of exposure limits mentioned is **desperatel**y **needed** at present.

Furthermore, a significantly large body of peer reviewed scientific papers now indicate that **gigabit-capable networks are predicted to be damaging to human health, as EMR exposure at levels 100K lower than those allowable by current 'safety' guidelines, cause actual biological damage to many types of cells not just human.** (see Tables 1, 2, & 3 which list all the scientific papers have been pulled out for Entrez Pubmed by just putting in the search term 'EMF radiation' and which describe multiple negative biological effects in many species). Of note are the biological indicators in Table 3 below such as bee colony collapse, bee developmental delay and bee motor damage and this is backed up by news articles such that written by Jo Lamiri in the Independent: (3 August 2018) stating: "***one-third of the UK's bee population has disappeared over the past decade** and 24 per cent of Europe's bumblebees are now threatened with extinction*." https://www.independent.co.uk/life-style/food-and-drink/national-honey-bee-day-save-species-decline-pollinators-environment-pesticides-a8461426.html

We should not wait until we have **damaged so many species including ourselves** before we stop and take stock of what we are doing to ourselves and to our environment.

If such gigabit-capable networks are not managed with a true understanding of the wealth and breadth of scientific data that is currently published, we will only know its damaging impact many years hence, and then it will be too late, as the damage will then already have been done to us, and subsequent generations and to our delicate ecosystem.

There is a current lack of understanding in this country of the wealth of scientific data that points to real biological negative effects by EMR, and we need to think about ways to limit that damage to our population and environment.

The Nuremberg trials and subsequent Code were supposed to ensure that never again would a population be experimented upon or harmed without consent. It is morally and legally wrong for the flawed ICNIRP guidelines to be condoned or supported like they are currently in this country, as they flagrantly disregard key scientific data pointing to non-thermal negative biological effects of pulsed EMR exposure, in all manner of species (e.g. Halgamuge MN. (2017) – see Table 3).

The mobile and broadband industry are making statements that are on face value misleading and deceptive and forcing foreseeable risk of harm upon a partly non-aware (e.g. misled), and partly aware and non-consenting population. See their comment from the Guardian below:

https://www.theguardian.com/technology/2020/mar/12/5g-safe-radiation-watchdog-health?CMP=share_btn_fb&fbclid=IwAR3NS278WnlgENmtaAd1CVy4jHWH_Y0L0cDiu6fBMcsOSG6HMWaCCnNnqNA

"*But millimetre-wave 5G, and other broadcast connections above the 6GHz band, "were not anticipated in 1998", according to Dr Jack Rowley, the senior director for research and sustainability at GSMA, the industry body for mobile network operators.*
Higher frequencies interact with organic tissue differently, dissipating more energy at the surface and penetrating less, which means the new standards take measurements across a smaller cross section, and specifically pay attention to the power absorbed by, rather than simply exposed to, a body.
"The most important thing is that the fundamental health risk assessment is unchanged," Rowley said.
*"**The limits that we had in 1998 are still protective now."***

However, Denis Henshaw, Emeritus Professor of Human Radiation Effects, School of Chemistry, University of Bristol, states in the following article:

"***The idea that since cell phone radio waves do not have the quantum energy to damage DNA and therefore cannot cause ill health is a fallacy.*** *It is flawed at a number of levels, from the very physics upon which it is supposedly based, to chemistry and biology. Most of all, the idea is not born out by the tens of thousands of peer-reviewed studies reporting biological effects from exposure to electric, magnetic and electromagnetic fields and electromagnetic radiation, including those associated with radio wave frequencies used by cell phones."*

https://ehtrust.org/wp-content/uploads/Henshaw-2019-Non-ionising-radiation-quantum-energy-fallacy-11th-April.pdf

Hertzgaard and Dowie (2018) [21] further state that " *the wireless industry has obstructed a full and fair understanding of the current science, aided by **government agencies that have prioritized commercial interests over human health** and **news organizations that have failed to inform the public about what the scientific community really thinks**. In other words, this public-health experiment has been conducted **without the informed consent of its subjects**, even as the industry keeps its thumb on the scale*."

Wilke, I (2018) [19] also states: "*The **potential health impact of Wi-Fi**, even at low exposure levels, **can no longer be called into question or relativized away**, not even by those studies that found no effects. The **decision-makers in government, school boards, and health agencies have a responsibility to deal with the available body of research** and not to be **deceived** by the arguments of the industry lobby or boilerplates of government institutions. Health risks are a reality.*

2.10 What Needs to Happen

Not everyone in every community in this country needs or wants superfast broadband / mobile connectivity.
Individual connectivity needs are different across this country. 5G roll out should only ever have been considered:

1. ***after*** appropriate safety testing had been completed by the mobile and broadband industry as well as independent scientific bodies and
2. ***after*** consultation with people in this democratic country as to its downstream health, economic and sociological impact on our future overall wellbeing

If gigabit connectivity is necessary for particular industries, it should be made available in a manner that **doesn't compromise the safety, health and wellbeing of the rest of the UK**, where lower speed connectivity is sufficient for a given community. Where gigabit connectivity has to be installed for functional and economic reasons, a solution should be sought which **removes long term EMR exposure of all constituents in that area**, **by using wired fibre optic solutions**, thereby also removing detrimental health effects due to wireless EMR-instigated negative biological responses which is likely to result in chronic and possibly acute diseases in the future, in exposed populations. Naren *et al*. (2020) [24] state: "*The carcinogenic nature of EMR which results in mutation of sperm cells*

as well as testicular cancer has also been reported [22]. ***Thus, the probability that future generations will inherit unhealthy or low-immunity genes is also increased*****."**

Table 3 shows the existence of damaging outcomes to multiple reproductive systems both human (Santini et al 2018) and other species like rat (Sepehrimanesh *et al* 2017; Yang *et al* 2018; Oh *et al* 2018) and mice (Li *et al* 2017), by EMR exposure which backs up Naren *et al*. (2020) [(23)] in their prediction above that **future generations are most at risk**. Both Pall (2018) [(29)] and Wilke (2018) [(19)] advocate **getting rid of Wi-Fi in schools** to protect future generations as well as teachers from EMR damage.

Santini *et al*. (2018) [(17)] after showing **oxidative stress effects of EMR radiation in male and female reproductive systems** urge that we should be aiming to get "*a better understanding of the molecular mechanisms underlying EMR potential challenge to our reproductive system in order to* ***improve preventive strategies****."*

5G networks have already been installed in various parts of the UK and local residents are uninformed about the dangers of 5G. **Such affected residents should be retrospectively informed** as to the massive body of scientific data that points to negative non-thermal biological responses to pulsed electromagnetic radiation, and **told that existing 5G has had no safety testing**. They should be told that **existing installations will be decommissioned until further notice**, and that **future 5G roll outs will be halted**, until adequate safety testing has been conducted. It is very likely that already deployed installations of 5G are already having a **direct, negative, cumulative effect on the short term and long term health of the UK public**. For example, one of the biological responses to continuous exposure to electromagnetic radiation is to also negatively affect the behaviours of autistic individuals - see link below and in Table 3 of this document.
https://bioinitiative.org/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf

The government, PHE, AGNIR, HPA, local authorities and Ofcom should **rethink how they assess the safety, ethics and use of not just mobile and broadband technologies but others as well**. They heavily rely on a non-independent body (ICNIRP) for their safety guidelines on current EMR exposure limits. Not only that, they are too **heavily reliant on segregated government bodies and the mobile and broadband industry themselves**, for their understanding of EMR emitting emerging technologies. These bodies need to have members of the public as **independent scrutinisers** in order for them to be held accountable to ensure that they are indeed acting in the best interests of all of the UK population.

Clearly the AGNIR and the HPA too are governed by the flawed safety guidelines of the ICNIRP as they state on the below website the following:

"*AGNIR's main conclusion is that, although a substantial amount of research has been conducted in this area,* ***there is no convincing evidence that RF field exposures below guideline levels cause health effects in adults or children.*** *These "guideline levels" are those of the International Commission on Non-Ionizing Radiation Protection, which already form the basis of public health protection in the UK and in many other countries.*
AGNIR concludes there is increasing evidence that ***RF fields below guideline levels do not cause symptoms and cannot be detected by people, even those who consider themselves sensitive to RF fields****.* ***HPA agrees with AGNIR that this does not undermine the importance of the symptoms that are experienced,*** *but it does suggest causes other than those directly related to RF fields should be considered. HPA will undertake another comprehensive review of the scientific evidence and its advice when sufficient new evidence has accumulated*."

See also below statement by the HPA on smart meters:

"*The results confirm PHE's existing advice that exposure to* ***radio waves from smart meters is well below the guidelines*** *set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)*."

https://www.gov.uk/government/publications/radiofrequency-electromagnetic-fields-health-effects/health-protection-agency-response-to-the-2012-agnir-report-on-the-health-effects-from-radiofrequency-electromagnetic-fields

As long as the health governing bodies that advise the government like the PHE, AGNIR, HPA, and Ofcom are blinded by the flawed guidelines of the ICNIRP, and not bothering to look at actual biological data such as that in Tables 1, 2 & 3 that from Entrez Pubmed, the government too, will continue to make misguided decisions. There needs to be a **major realisation** in government that **real scientists are speaking out** to alert them of the **dangers of EMR exposure** to the public. If nothing else they need to **stop allowing industry to upgrade mobile and digital technology without doing adequate safety checks and without consulting the public**. There is enough data out there now, for the UK government to be held accountable for blinded decisions.

It seems like the PHE, AGNIR or HPA are not **independently assessing the scientific data**, or they would have come to the conclusion that low level EMR is having a direct, visible, detectable, measurable and negative biological impact on multiple species not just humans. EMR exposure needs to be **understood and managed safely,** rather than allowing the mobile and broadband industry to upgrade to more penetrating and more pervasive digital technologies like **5G, which requires denser base stations in the network**, exposing the public to **several fold higher and continuous EMR** than ever before, (see Naren et al 2020 [23]) without adequately considering the impact of such frequencies on the health of the public and the ecosystem around us.

The government's own website states that the 5G network will need to be more dense: "***5G is expected to see a greater number of small cells*** *(low powered base stations that can be mounted on* ***buildings and street furniture****) and will* ***require wider deployment of full-fibre broadband infrastructure***." (https://commonslibrary.parliament.uk/research-briefings/cbp-7883/#fullreport) The Future Telecoms Infrastructure document from government states: "***Spectrum at very high frequencies*** *(so-called 'millimetre wave' spectrum) can provide much higher data throughput, but will cover* ***much smaller areas and cannot penetrate through walls****. 5G deployments in these bands are, therefore, likely to be focused in specific locations requiring services with very high capacity."* What is unclear is exactly where these specific locations will be, and how safe such areas will be for people and the environment. It is clear that whichever way you look at it, the more dense the urban area that you live in, the greater the EMR smog of dirty electricity that you will be subjected to – see statement below from the Future Telecoms Infrastructure document : "*Publicly-owned assets, such as* ***streetlights, CCTV networks, and buildings****, could be ideal* ***for the siting of wireless infrastructure, in particular small cells****; local authority* ***underground cable duct networks*** *can also be useful to enable the* ***installation of the dense fibre networks needed to connect small cell networks."***

The government needs to be made aware that due to the base station density required for 5G to be effective, people will be exposed to 60GHz frequencies of **EMR indoors and outdoors with no chance of ever being able to switch it off.** This is dangerous and all the scientific peer reviewed data for 2G-4G frequencies (1900 MHz – 2.6GHz) is already pointing to damaging biological effects for frequencies of EMR from existing digital sources (see Tables 1, 2 & 3).

It is important when scientists worldwide, are calling for a moratorium, on the roll out of 5G, for reasons that lower frequencies than 5G are already causing negative biological responses, **that questions should be asked** of the government, local authorities, Ofcom and the mobile and broadband industry, by *an* ***independent scientific committee (ISC).***

This committee should consist of:

1. Representatives from the scientific community who are ***independent*** of the mobile and broadband industry
2. Concerned members of the public *with* ***no overt affiliation***, and

3. Members of ***EMR-aware public-centric*** organisations like that of the Radiation Research Trust and PHIRE (Physicians' Health Initiative for Radiation and Environment).

Such an ISC should ask the above stakeholders how future emerging microwave technologies like 5G are being assessed for:

1) overall public benefit (not just economic but sociological)
2) overall public wellbeing (physical and mental) and
3) continued health of future generations in the UK.

All three of the above criteria need to be met before emerging technologies like 5G are disseminated within the population. This is not the case with 5G as we already know that already deployed EMR at lower frequencies than 5G has negative effects on our physical wellbeing, and exposure to these frequencies is having a **negative effect on future generations** such as our adolescents (Meo *et al*. (2018) (Table 1) and children (Fernández *et al*. (2018) (Table 3).

Barnes & Greenebaum (2020) [(25)] believe a **carefully targeted program of government research funds** is called for, supplemented by communications system operators and corporations that manufacture equipment, under independent scientific management. Both governmental and private entities that emit RF signals would be well advised to **fund research to elucidate and define threshold signal levels** for the generation of long-term biological effects.

MP's and Mayors seem to **heavily rely on other government bodies such as PHE**, to inform them of the safety of emerging technologies like 5G, who in turn rely on another **non-independent body such as the ICNIRP**. If a body such as the ICNIRP displays any **scientific bias** when assessing the biological impact of emerging EMR technologies such as 5G from the mobile and broadband sectors, **without adequate concern for public health**, this results in **misguided policy making** by government, which will result in **definite long term harm** to people in the UK.

MP's, Mayors, health bodies like the PHE, HPA & AGNIR, local city council digital teams and planning committees all need to use **joined up thinking** with respect to the public's concerns of how and where and what 5G / gigabit installations are implemented. They **should all work together to resolve matters of safety and public welfare** – be they regarding our health, economic, sociological or environmental welfare. Each of these bodies need to be **accountable and have a good understanding of the impact of their decisions** regarding emerging technologies and their impact on existing and future generations as well as our environment. Currently, it seems like they are **passing the buck from one government department to the other**, instead of taking ownership of the problem.

The disregard of the ICNIRP of important scientific data on EMR damage, has resulted in the current situation in the UK where current PHE safety guidelines used by this government are **deeply flawed**, and unfortunately reams of peer reviewed scientific data pointing to very real negative biological responses to EMR exposure, in humans and other species, **have been ignored**. Concerned scientists need to **speak out**, to highlight current misguided decisions by government. Independent science has been **shouting to the tree tops** since the 1970's that the global health of humans and other species is being **damaged by rampant and ever increasing EMR radiation** but governments world-wide seem to be not listening.

The UNESCO 2005 Precautionary Principle (PP) [(22)] states: "*Companies need to become **partners with the public and the administration**, and they thus need to adopt a principled attitude of transparency and knowledge sharing….Yet, precaution typically involves public consultations, deliberations and hearings that may focus on selected side effects or possible harms. Such consultations are **often deemed avoidable and obstructive** by business. Yet product development strategies that do not take account of community values will often place the company in the position of having to **defend risky products**. The call for precaution is then seen as anti-industrialist, anti-innovation and anti-technology. Yet, several companies now realize that this can be avoided if their*

product development is made more flexible and responsive to outside input from the very beginning. …To the extent that companies manage to integrate the spectrum of outside concerns at an early stage, they stand a better chance to come up with products that are widely seen as good solutions. Precautionary measures should in any case be judged transparently on a case-by-case basis, and be subjected to scrutiny from many parties….Implementation of the PP needs to accommodate various cultures of risk regulation and administrative regimes, while still addressing the basic tenets of the PP (uncertainties, science, values, transparency and participation, etc.)

The roll out of 5G in the UK has not had any address to the public of its safety. There has been no independent scrutiny by many parties of the scientific data regarding 5G for the public to be convinced that it is a good solution for better *and* safer connectivity. There is no safety testing data available at all for 5G in the UK. There has been **no attempt** by the companies that have rolled out 5G to become 'partners with the public.' In fact, the public are **unaware of the safety data around 5G**, they have **not been involved in its roll out**, and there have been **no deliberations involving the public** in the UK that have addressed side effects or possible harms. In fact, the Precautionary Principle has been completely ignored with respect to 5G roll out.

This needs to be addressed urgently by the government and all stakeholders. The UK needs a moratorium on future 5G roll outs. It needs to switch off 5G from deployed masts until safety testing has been completed. We also need to take measures now to protect ourselves and children from Wi-Fi long term (see section 2.11).

The people of the UK need to vote with its feet, as currently the **government wants to switch off copper wire services** (i.e. landlines) and **only supply fibre services which means those who don't want to communicate via mobiles or don't want the internet in their homes will be disadvantaged**. The government only expects switchover to start when a significant proportion of the population has taken-up new fibre services. So we need to essentially not switch to 5G and use our portable devices less , if we are going to protect our society from being steamrollered into 5G and wireless solutions. **We should not upgrade our phones or broadband services to 5G, as it will be commercially less viable for mobile companies to roll out 5G at more UK sites**.

We need to **object to the 5G roll out** by writing to our MP's and contributing evidence to government consultations, writing to our local city councils and health authorities (Public Health) and objecting to ongoing planning applications (see Section 2.12).

2.11 5G is likely to Pose a Greater Harm than its Predecessors

Naren et al (2020) [23] state: "*5G is set to use frequencies between 30 GHz and 100 GHz and would have a bandwidth of 60 GHz, which is **much higher than all previous generations**. Owing to the increased frequency, the wavelengths in 5G communications will be in the order of few millimeters. Shorter wavelengths travel shorter distances; therefore, **5G networks will be much denser** compared to existing networks. This necessitates **that more base stations** be placed at much closer distances in order to achieve good coverage… in the case of 5G networks, the base station (BS) density is expected to be increased to about **40-50 base stations/km^2** due to the high propagation loss of millimeter wave technology. The area served by each base station in 5G networks is very small and is commonly called a small cell. The shorter millimeter waves would also not be able to penetrate building walls effectively. Therefore, the 5G architecture will separate indoor and outdoor networks, which means there will be separate access nodes for indoor users. 5G BSs will also be installed on **street light poles** meaning that people will be **extremely close to the BS antennas**, whether they are indoors or outdoors. In addition, 5G will also employ relay nodes that amplify the wireless signals from the BSs before they reach the device. The high data rate requirement of 5G, which is around **1000 times more than 4G**, is expected to be solved by the use of massive-MIMO technology, which incorporates a large number of antennas. Thus, 5G networks contain Macrocells, microcells, relays, street light access points and separate indoor nodes, which operate simultaneously all the time. Due to the extremely high density of BSs, street light access points, separate indoor BSs, relays and Massive MIMO technology employed in 5G, a **person will be exposed to very high***

levels of power flux densities (PFDs), whether he is indoors or outdoors*, or whether or not he is using any wireless devices in close proximity. In other words, it may be suspected that even the ambient PFD which a person is exposed to in most situations throughout the day may fall under the category of `**Severe Concern'** according to the Building Biology Standard, `**Far above normal'** according to the AMA standards, and may be **higher than the precautionary action level** recommended by the BioInitiative Guidelines."*

Pall (2019) [(2)] predict that similar but much **more severe effects** are likely to be produced by 5G than seen currently. He also predicts that because of the roles of aqueous dissolved ions in producing these deep effects, that **regions of the body with large such internal "bodies of water**" may be expected to produce particularly severe problems. These are as follows:

1. Various types of **birth defects** because of the role of the amniotic fluids and the increased extracellular water content in the tissues of the foetus.
2. **Blindness** due to the role of the aqueous and vitreous humours of the eye.
3. **Kidney failure** due to the water in the kidney.
4. **Cardiac changes** in the electrical control of the heart, because of the large blood fluids in the heart.
5. **Circulatory problems**, possibly including aortic and other arterial aneurisms.

Ofcom has published the latest results from their spectrum measurement programme, including six additional 5G mobile sites: (see link: https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/clearing-up-myths-5g-and-coronavirus)

"*At every site, emissions were a small fraction of the levels included in international guidelines. These guidelines are set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The maximum measured at any mobile site was **approximately 1.5%** of those levels – including signals from other mobile technologies such as 3G and 4G. The **highest level from 5G signals specifically was 0.039%** of the maximum set out in the international guidelines*."

The maximum level set out by the ICNIRP is: 10,000,000 $\mu W/m^2$ (Table 4). This means that the highest level at any 5G mobile site which consists of 3G, 4G & 5G would be **150,000 $\mu W/m^2$** and the highest level from 5G signals specifically would be **3,900 $\mu W/m^2$**. The 'No Concern / Within Normal Limits' level for the BB and AMA standards is <1 $\mu W/m^2$ and the Extreme Concern / Far Above Normal Limit' level is 1000 $\mu W/m^2$. Therefore, the level for 3-5G at 5G sites is **150,000 fold** higher than what is considered normal by the BB and AMA standards. The level for 5G only is **3900 fold** higher than what is considered normal by the BB and AMA standards.

This is **deeply alarming** as low level EMR negative biological effects occur in rats at only 1 mW/cm^2 (cognitive impairment) (Tang et al 2015) and in adolescents at between 2-10 $\mu W/cm^2$ (spatial working memory and attention impairment, delayed motor skills) (Meo et al 2018) – see Table 3.

The other issue around 5G which is of deepest concern is the fact that various companies with a financial interest in 5G technologies and products are currently busy launching satellites into our ionosphere at a prolific rate. What this means is that the earth will be enveloped in such a deep electrosmog, that effectively there will be no escaping the intense electromagnetic radiation emitted by these satellites anywhere on the planet. The impact of this will be catastrophic, considering the negative biological data we already currently have on the damage caused by 2G-4G emissions, which are much less intense than 5G and yet able still to cause chronic effects. Arthur Firstenberg has been monitoring the launches of satellites into space and you can learn more about this deeply concerning problem at the link below:

https://www.cellphonetaskforce.org/?s=satellites&submit.x=0&submit.y=0

He has appealed to all citizens on earth to sign an appeal to all governments to stop 5G – see link below to sign the petition:

https://www.5gspaceappeal.org/thank-you-post-signature

2.12 What You Can Do Now to Protect Yourself from EMR

People can make the following interim changes to their lifestyle to protect themselves right now:

1. Switch off the Wi-Fi router when not needed especially overnight when you are sleeping as the body heals as you sleep and it is wise to give your body the maximum chance to recuperate and heal itself
2. Look into wired connections for your portable devices which connect directly to the router to connect them to the router: https://www.emfanalysis.com/how-to-install-wired-internet-in-your-home/ and http://blog.chron.com/techblog/2014/06/want-to-use-your-own-modemrouter-with-comcast-heres-how/
3. Look at the Table 5 below from Naren et al 2020 [23] to work out distances to use portable devices when you can't avoid having to work in a Wi-Fi environment
4. Look at methods of shielding yourself by researching products at : https://www.radiationhealthrisks.com/recommended-protections/
5. Measure the EMR in your home by purchasing a dosimeter: https://www.radiationhealthrisks.com/best-emf-rf-meters-and-detectors/

2.13 How to Object

1. You can object to the roll out of 5G by submitting your comments to the following government consultation:

https://committees.parliament.uk/call-for-evidence/22/broadband-and-the-road-to-5g/

2. You can write to your MP, Mayor, Public Health England, local city councillor to register your concern
3. You can object to mast installations at the planning website of your local city council e.g. https://eplanning.birmingham.gov.uk/Northgate/PlanningExplorer/NotDecidedSearch.aspx
4. See below Appendix for a template objection letter you could use. You need to look at all associated documents with respect to a mast installation, and identify where it will be located, i.e. close to a school or in a densely residential area and put forward the arguments that safety testing has not been done and much compelling scientific data now exists pointing to the damaging effects of electromagnetic radiation for humans and all species.
5. You can find out where 5G is being deployed and where it has already been deployed at:
    a. https://ee.co.uk/why-ee/5g-on-ee/5g-uk-coverage
    b. https://5g.co.uk/coverage/three/#Next
    c. https://5g.co.uk/coverage/three/#Which%20cities%20have%20Three%205G%20now?

2.14 What to Expect

As you can by now see, the government has been paid a massive sum (£1.4 billion) by the mobile and broadband industry for access to the airways for the frequencies they need to implement 5G, so they are unlikely to respond with appropriate concern for evidence that pushes them away from this economic pressure.

The government is also contending with local planning authorities **to not seek to determine the health safeguards** of 5G planning proposals and whether the International Commission (ICNIRP) guidelines for public exposure are deeply flawed. This is their statement to the local planning authority (LPA): "The National Planning Policy Framework clearly states that authorities should NOT question the need for the service, nor seek to prevent competition between operators."
"The support for telecoms and the need not to constrain Operators is laid out in Paragraph 116 : Local planning authorities must determine applications on planning grounds only. They should not seek to

prevent competition between different operators, question the need for an electronic communications system, or set health safeguards different from the International Commission guidelines for public exposure."

It is likely that your MP and Mayor are pro-5G as this is the standard government stance and currently they are unlikely to have the scientific experience to assess evidence effectively. They are initially likely to refer you to a standard reply directing you to a website such as this, which will state that the PHE follows the guidelines set by the ICNIRP: https://www.gov.uk/government/publications/mobile-phone-base-stations-radio-waves-and-health

When pressed further, you are likely to find out where they stand based on their loyalties to the government's current agenda, which is to roll out 5G across the country with no concern for its health implications.

2.15 Legal Case Against the Government

There is a legal case currently ongoing against the government. **Michael Mansfield** QC has filed a case:

"We bring this case because we lack confidence in Public Health England. PHE has dismissed multiple warnings from both government and independent scientists including many Scientific Committees for Health and the evidence of thousands of peer reviewed scientific papers. Instead it accepts outdated opinions from unreliable and unaccountable agencies. Since 2000, when The Stewart Report recommended the government apply the precautionary principle to electro-magnetic radiation, the government has failed in its duty to protect health. Our concerns include the imposition of radiation on the population without consent and the serious matter of privacy, surveillance and social control."
https://actionagainst5g.org/

There is also a crowd funding page currently to support a solicitor, **Jessica Learmond-Criqui** who is seeking to get a change of government policy to stop the harm to UK residents, which would include:

1. An immediate halt to the roll out of 5G infrastructure until it is proven to be safe;
2. Direct all such businesses and persons to turn off all equipment which propagate wireless 5G signals including without limitation masts, antennae, wifi (including in schools), small cells;
3. Direct all products which use 5G wireless technology to be recalled as they are not safe;
4. Direct that the manufacture of all products using 5G wireless technology be halted.
5. Require the government to ensure that the industry lays cabling for the purposes of upgrades in technology rather than relying on wireless technology generating RFR and EMFs;
6. Require the government to examine all equipment and gadgets generating RFR and to take steps to ensure that such equipment does not cause harm to humans.

3. Conclusion

5G technology that has been implemented in this country is **untested** as to the dangers it is placing mankind under. Naren et al 2020 (23) have said this could be 'calamitous' and needs to be addressed as a matter of great urgency by our government and all our regulatory health bodies.

Government should urgently re-evaluate their 5G roll out strategy in the light of so much negative biological evidence with respect to existing EMR. As 5G is predicted by many scientists world-wide to result in even more negative genetic, biochemical and morphological effects that will occur in time and are probably already concurrent, this problem urgently needs to be resolved for our safety.

We have the opportunity to take positive actions to implement broadband connectivity more safely across the UK, i.e. by using **wired fibre optic technology**, which will be in the best interests of all our people, our environment and the delicate ecosystem around us. The summary above suggests ways

and means to **resolve the existing unknowns** around the safety of 5G (Summary, point 14, page 2-6 of this document) so that the mobile and broadband industry which produces products and services are held **accountable to the public**.

This country needs to **implement a strategy** which uses **independent intervention and scrutiny** by non-industry led scientists and stakeholders (i.e.an ISC) who can **probe all safety testing data** by the mobile and broadband industry as well as associated scientific studies by independent scientists, so that the mistakes made by governments globally in allowing the tobacco and fossil-fuel industries to proliferate without adequate regulatory and economic control, ***will not be repeated in the wireless industry as well.***

Table 3: More Negative EMR effects Published in the Literature

Negative Effect by EMR radiation	Paper	Findings and actions	Species
Children eyes and brains a**re absorbing most radiation**	Fernández C, de Salles AA, Sears ME, Morris RD, Davis DL. Environ Res. 2018 Nov;167:694-699. **Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality.**	**Finding**: Modeling of a cell phone held to the ear, or of virtual reality devices in front of the eyes, **reveals that young eyes and brains absorb substantially higher local radiation doses than adults.** **Action**: Age-specific simulations indicate the need to apply refined methods for regulatory compliance testing; and for **public education regarding manufacturers' advice to keep phones off the body, and prudent use to limit exposures, particularly to protect the young.**	Human (children)
Neurodevelopment and neurobehavioural damage in children	Sage C, Burgio E.Child Dev. 2018 Jan;89(1):129-136. **Electromagnetic Fields, Pulsed Radiofrequency Radiation, and Epigenetics: How Wireless Technologies May Affect Childhood Development.**	New epigenetic studies are profiled in this review to account for some neurodevelopmental and neurobehavioral changes due to exposure to wireless technologies. **Symptoms of retarded memory, learning, cognition, attention, and behavioral problems have been reported in numerous studies and are similarly manifested in autism and attention deficit hyperactivity disorders, as a result of EMR and RFR exposures** where both epigenetic drivers and genetic (DNA) damage are likely contributors.	Human (children)

Cognitive impairment in rats by EMRs	Tang J, Zhang Y1, Yang L, Chen Q, Tan L, Zuo S, Feng H, Chen Z, Zhu G. Brain Res. 2015 Mar 19;1601:92-101. **Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats.**	Male Sprague-Dawley rats were exposed to a **900 MHz, 1 mW/cm^2 EMR or sham (unexposed) for 14 or 28 days (3h per day).** The specific energy absorption rate (SAR) varied between 0.016 (whole body) and 2 W/kg (locally in the head). The frequency of crossing platforms and the percentage of time spent in the target quadrant were lower in rats exposed to EMR for 28 days than in rats exposed to EMR for 14 days and unexposed rats. 28 days of EMR exposure induced cellular edema and neuronal cell organelle degeneration in the rat. In addition, damaged BBB permeability, which resulted in albumin and HO-1 extravasation were observed in the hippocampus and cortex. EMR exposure for 28 days induced the expression of mkp-1, resulting in ERK dephosphorylation. Taken together, these results demonstrated that **exposure to 900 MHz EMR radiation for 28 days can significantly impair spatial memory and damage BBB permeability in rat by activating the mkp-1/ERK pathway.**	Rat
Tree damage	Waldmann-Selsam C, Balmori-de la Puente A, Breunig H, Balmori A. Sci Total Environ. 2016 Dec 1;572:554-569. **Radiofrequency radiation injures trees around mobile phone base stations.**	Statistical analysis demonstrated that **electromagnetic radiation from mobile phone masts is harmful for trees.** These results are consistent with the fact that **damage afflicted on trees by mobile phone towers usually start on one side, extending to the whole tree over time.**	Plant (Trees)

Strong causality of brain cancer by EMRs	Pareja-Peña F, Burgos-Molina AM, Sendra-Portero F, Ruiz-Gómez MJ. Int J Environ Health Res. 2020 Mar 9:1-10. **Evidences of the (400 MHz - 3 GHz) radiofrequency electromagnetic field influence on brain tumor induction.**	Epidemiological studies noticed a **causal association between the exposure to RF-EMR and the incidence of brain neoplasm in different populations**, since this is the organ with the highest specific absorption rate. **The fact that so many of the ipsilateral tumors found are statistically significant with RF-EMR exposure provides weight suggesting causality**. In this way, **the higher the exposure (ipsilateral vs contralateral), the longer the cumulative exposure (hours of exposure) and the longer the latency (beyond 10 years); the greater the risk**. In addition, **considering together all of these parameters suggest a strong causality.**	Human (adults)
Brain Cancer and J-shaped dose response curves as a result of EMRs	Mortazavi S. M. J., Mehdizadeh A R, M H. J Biomed Phys Eng. 2019 Aug 1;9(4):487-494. doi: 10.31661/jbpe.v0i0.771. eCollection 2019 Aug. **Evaluation of the Validity of a Nonlinear J-Shaped Dose-Response Relationship in Cancers Induced by Exposure to Radiofrequency Electromagnetic Fields.**	**The magnitude of exposure to RF-EMRs plays a basic role in RF-induced carcinogenesis.** There is some evidence indicating that, in a similar pattern with ionizing radiation, the carcinogenesis of non-ionizing RF-EMR may have a nonlinear dose-response relationship. **In this paper, the evidence which supports a nonlinear J-shaped dose-response relationship is discussed.**	Human (adults)
Human cancer cell proliferation by EMRs	Song K, Im SH, Yoon YJ, Kim HM, Lee HJ, Park GS. PLoS One. 2018 Jul 16;13(7):e0199753. **A 60 Hz uniform electromagnetic field promotes human cell proliferation by decreasing intracellular reactive oxygen species levels.**	Previously, we showed that **exposure of human normal and cancer cells to a 6 mT, 60 Hz gradient electromagnetic field (EMR) induced genotoxicity**. Here, we investigated the cellular effects of a uniform EMR. ...However, **continuous exposure of HeLa and primary IMR-90 fibroblasts to an EMR promoted cell proliferation**. **This increase in cell**	Human (Cell lines)

		proliferation was directly correlated with EMR strength and exposure time. These results demonstrate that **EMR uniformity at an extremely low frequency (ELF) is an important factor in the cellular effects of ELF-EMR.**	
Testicular cancer markers increased by EMRs	Sepehrimanesh M, Kazemipour N, Saeb M, Nazifi S, Davis DL. Environ Sci Pollut Res Int. 2017 May;24(15):13666-13673. **Proteomic analysis of continuous 900-MHz radiofrequency electromagnetic field exposure in testicular tissue: a rat model of human cell phone exposure.**	**Finding**: Our results indicate that exposure to **RF-EMR produces increases in testicular proteins in adults that are related to carcinogenic risk and reproductive damage. Action**: In light of the widespread practice of men carrying phones in their pockets near their gonads, where exposures can exceed as-tested guidelines, further study of these effects should be a high priority.	Rat
Bee colony collapse by EMRs	Santhosh Kumar S. Bioinformation. 2018 Dec 21;14(9):421-424. **Colony Collapse Disorder (CCD) in Honey Bees Caused by EMR Radiation.**	Recent studies reveal that a cell phone tower and mobile phone handset are also causing side effects to honey bees due to radiation emission. Most of the researchers concentrated on biological and behavioral changes in a honey bee due to radiation effects. This study aimed to provide possible research extensions of colony **collapse disorder caused by cell tower and mobile handsets.**	Insect (bees)
Bee queen developmental delay by EMRs	Odemer R, Odemer F. Sci Total Environ. 2019 Apr 15;661:553-562. **Effects of radiofrequency electromagnetic radiation (RF-EMR) on honey bee queen development and mating success.**	We have therefore exposed honey bee queen larvae to the radiation of a common mobile phone device (**GSM band at 900 MHz**) during all stages of their pre-adult development including pupation. We found that **mobile phone radiation had significantly reduced the hatching ratio but not the mating success.**	Insect (bees)
Bee cognitive and motor damage by EMRs	Shepherd S, Lima MAP, Oliveira EE, Sharkh SM, Jackson CW, Newland PL. Sci Rep. 2018 May 21;8(1):7932. **Extremely Low Frequency**	Here we ask how acute exposure to 50 Hz ELF EMRs at levels ranging from 20-100 μT, found at ground level below	Insect (bees)

	Electromagnetic Fields impair the Cognitive and Motor Abilities of Honey Bees.	powerline conductors, to 1000-7000 μT, found within 1 m of the conductors, affects honey bee olfactory learning, flight, foraging activity and feeding. ELF EMR exposure was found to reduce learning, alter flight dynamics, reduce the success of foraging flights towards food sources, and feeding. The results suggest that **50 Hz ELF EMRs emitted from powerlines may represent a prominent environmental stressor for honey bees, with the potential to impact on their cognitive and motor abilities, which could in turn reduce their ability to pollinate crops.**	
Oxidative stress caused by EMR exposure to power plant workers is alleviated by reseveratol	Zhang D, Zhang Y, Zhu B, Zhang H, Sun Y, Sun C. Oncotarget. 2017 Jul 18;8(29):47497-47506. **Resveratrol may reverse the effects of long-term occupational exposure to electromagnetic fields on workers of a power plant.**	Workers who had long-term exposure to high-voltage electricity lines exhibited elevated urinary levels of 8-hydroxy-2-deoxy-guanosine (8-OHdG) and F2-isoprostane, compared to the reference group. Lower plasma nuclear factor kappa B (NF-κB) and interleukin (IL)-6 were observed in exposed workers compared to the reference group. Resveratrol significantly reversed the adverse impacts of ELF-EMR. Stimulated cytokine production by resveratrol was found in exposed workers but not in the reference group. This study supported that occupational and **long-term exposure to high-voltage electricity lines has an adverse effect on homeostasis of human body**, and resveratrol supplement could be an effective protection strategy against the adverse effects induced by ELF-EMRs	Human (adult)

Oxidative stress in the nematode worm by EMRs	Sun Y1,2,3, Shi Z2,4, Wang Y1,2,3, Tang C1,3, Liao Y1,3, Yang C1,3, Cai P1,3. Int J Radiat Biol. 2018 Dec;94(12):1159-1166. **Coupling of oxidative stress responses to tricarboxylic acid cycle and prostaglandin E2 alterations in Caenorhabditis elegans under extremely low-frequency electromagnetic field.**	The objective of the present study was to investigate the physiological responses of Caenorhabditis elegans (C. elegans) to **50 Hz, 3 mT ELF-EMR exposure**. The TCA cycle enzyme, fumarase was found with decreased expression under ELF-EMR exposure. And arachidonic acid (ArA) and prostaglandin E2(PGE2) showed elevated concentrations, with increased expression of prostaglandin E2 synthase (PGES-2) in ELF-EMR exposed worms. Our results suggested that exposure to 50 Hz, 3 mT ELF-EMR in C. elegans can **elicit disruptions of the TCA cycle metabolism and PGE2 formation, coupling ELF-EMR-induced oxidative stress responses**. Our study probably will attract increasing attentions to the controllable application of ELF-EMR associated with health and disease.	Worms (C.elegans)
Oxidative stress caused by EMRs in rat livers	Postaci I, Coskun O, Senol N, Aslankoc R, Comlekci S. Bratisl Lek Listy. 2018;119(8):481-489. **The physiopathological effects of quercetin on oxidative stress in radiation of 4.5 g mobile phone exposed liver tissue of rat.**	Postaci et al aimed to evaluate the physiopathological consideration of the **effects of electromagnetic field (EMR) from the radiation of 4.5 G mobile phones on the liver tissue of rats** and quercetin (Qu) applied as an antioxidant for reducing these effects. In the liver tissue of the electromagnetic field group; **dilatation of sinusitis was determined to be higher than in the sham group**. It was concluded that the concentration of caspase-3 and TNF-α immunopositive cells was in the EMR group (+3) level and also the immunostaining was stronger, **it caused an increase in malondialdehyde level, the difference between the groups was**	Rats

		statistically significant. It was determined that 2600 MHz EMR exposure caused damage to the liver, 100 mg/kg/day quercetin was not sufficient to prevent this damage	
Oxidative stress and EMR review	Kıvrak EG, Yurt KK, Kaplan AA, Alkan I1, Altun G. J Microsc Ultrastruct. 2017 Oct-Dec;5(4):167-176.**Effects of electromagnetic fields exposure on the antioxidant defense system.**	**Electromagnetic fields (EMR) have various chemical effects, including causing deterioration in large molecules in cells and imbalance in ionic equilibrium.** Despite being essential for life, oxygen molecules can lead to the generation of hazardous by-products, known as reactive oxygen species (ROS), during biological reactions. These reactive oxygen species can **damage cellular components such as proteins, lipids and DNA.** Antioxidant defense systems exist in order to keep free radical formation under control and to prevent their harmful effects on the biological system. Oxidative stress occurs if the antioxidant defense system is unable to prevent the harmful effects of free radicals. Several studies have reported that **exposure to EMR results in oxidative stress in many tissues of the body. Exposure to EMR is known to increase free radical concentrations and traceability and can affect the radical couple recombination.**	Human
Oxidative stress caused by EMRs in earthworms	Bourdineaud JP, Šrut M, Štambuk A, Tkalec M, Brèthes D, Malarić K, Klobučar GIV. Arh Hig Rada Toksikol. 2017 Jun 27;68(2):142-152. **Electromagnetic fields at a mobile phone frequency (900 MHz) trigger the onset of general stress response along with DNA modifications in Eisenia fetida earthworms.**	Eisenia fetida **earthworms were exposed to electromagnetic field (EMR) at a mobile phone frequency (900 MHz) and at field levels ranging from 10 to 120 V m-1 for a period of two hours (corresponding to specific absorption rates ranging from 0.13 to 9.33 mW kg-1).** All exposure treatments induced	Earthworms

		significant DNA modifications as assessed by a quantitative random amplified polymorphic DNA-PCR. Expression of **genes involved in the response to general stress (HSP70 encoding the 70 kDa heat shock protein, and MEKK1 involved in signal transduction), oxidative stress (CAT, encoding catalase), and chemical and immune defence (LYS, encoding lysenin, and MYD, encoding a myeloid differentiation factor) were up-regulated** after exposure to 10 and modulated 23 V m-1 field levels. HSP70 and LYS genes were up-regulated after 24 h of recovery following a two hour-exposure, meaning that the effect of EMR exposure lasted for hours.	
EMRs via Nitric Oxide signalling negatively impact responsiveness of rat heart ventricular myocytes	Olgar Y, Hidisoglu E, Celen MC, Yamasan BE, Yargicoglu P, Ozdemir S. Int J Radiat Biol. 2015;91(10):851-7. **2.1 GHz electromagnetic field does not change contractility and intracellular Ca2+ transients but decreases β-adrenergic responsiveness through nitric oxide signaling in rat ventricular myocytes.**	We investigated the effect of **2.1 GHz EMR on contractility and beta-adrenergic (β-AR) responsiveness of ventricular myocytes**. EMR exposure led to a **significant increase in nitric oxide levels in rat heart ($p < 0.02$)**. Long-term exposure to 2.1 GHz EMR decreases β-AR responsiveness of ventricular myocytes through NO signaling.	Rat
Multiple biological negative downstream disruptions caused by EMRs linked with autism spectrum conditions	Herbert MR1, Sage C. Pathophysiology. 2013 Jun;20(3):211-34. **Autism and EMR? Plausibility of a pathophysiological link part II.**	We reviewed pathophysiological damage to core cellular processes that are associated both with ASCs and with biological effects of EMR/RFR exposures that contribute to **chronically disrupted homeostasis**. Many studies of people with ASCs have identified **oxidative stress and evidence of free radical damage, cellular stress proteins, and deficiencies of antioxidants such as**	Human

		glutathione. This paper documents how **behaviors in ASCs may emerge from alterations of electrophysiological oscillatory synchronization**, how **EMR/RFR could contribute to these by de-tuning the organism,** and policy implications of these vulnerabilities. It details **evidence for mitochondrial dysfunction, immune system dysregulation, neuroinflammation and brain blood flow alterations, altered electrophysiology, disruption of electromagnetic signaling, synchrony, and sensory processing, de-tuning of the brain and organism, with autistic behaviors as emergent properties** emanating from this pathophysiology. Various vital but vulnerable mechanisms such as **calcium channels may be disrupted by environmental agents**, various genes associated with autism or the interaction of both. With dramatic increases in reported ASCs that are coincident in time with the deployment of wireless technologies, we need aggressive investigation of potential ASC-EMR/RFR links. The evidence is sufficient to warrant new public exposure standards benchmarked to low-intensity (non-thermal) exposure levels now known to be biologically disruptive, and strong, interim precautionary practices are advocated.	

Oxidative stress causes acute renal injury in rats	Bedir R, Tumkaya L, Mercantepe T, Yilmaz A. Arch Med Res. 2018 Oct;49(7):432-440. **Pathological Findings Observed in the Kidneys of Postnatal Male Rats Exposed to the 2100 MHz Electromagnetic Field.**	We therefore investigated oxidative stress and apoptosis in long-term exposure to 2100 megahertz (MHz) in a rat model. **Deterioration was observed in the brush border in renal tubules of the EMR groups**. The results of the immunohistochemical analysis revealed a **greater number of positively stained renal tubular epithelial cells in the EMR groups** as compared with that in the control group. In the EMR groups, **renal MDA levels increased, and renal GSH levels decreased compared with those in the control group**, as shown by a biochemical examination (p = 0.00 and p = 0.00, respectively). CONCLUSION: The findings showed that **exposure to 2100 MHz for 6 and 12 h induced oxidative stress-mediated acute renal injury, depending on the length of exposure and dosage.**	Rat
Pathological damage to adolescent rat kidneys	Okatan DÖ, Okatan AE, Hancı H, Demir S, Yaman SÖ, Çolakoğlu S, Odacı E. Toxicol Ind Health. 2018 Oct;34(10):693-702. **Effects of 900-MHz electromagnetic fields exposure throughout middle/late adolescence on the kidney morphology and biochemistry of the female rat.**	We investigated the **effects on the kidneys of female rats exposed to a continuous 900-megahertz (MHz) EMR for 1 h daily in mid-late adolescence**. **Findings**: including **hemorrhage in glomerulus, vacuolization and irregularity in the proximal and distal tubular epithelium, diffuse glomerular degeneration and edema, occasional degeneration in Bowman capsules, hemorrhage in the medullary region, disturbed nucleus location and morphology, and tubular edema in the cortex** were observed in the EMR groups. In conclusion, exposure to a continuous	Rat

		900-MHz EMR for 1 h daily during middle and late adolescence may cause various changes in the female rat kidney at postnatal day 60.	
Pathological damage to male rat kidneys and bladder	Türedi S, Kerimoğlu G, Mercantepe T, Odacı E. Int J Radiat Biol. 2017 Sep;93(9):990-999. **Biochemical and pathological changes in the male rat kidney and bladder following exposure to continuous 900-MHz electromagnetic field on postnatal days 22-59**	EMRG rats were **exposed to continuous 900-MHz EMR for 1 h a day** under the same conditions as those for the SG rats. **Tissue malondialdehyde increased in EMRG** compared to CG and SG in **both kidney** ($p = 0.004$ and $p = 0.004$, respectively) **and bladder** tissue ($p = 0.004$, $p = 0.006$, respectively), while **catalase and glutathione levels decreased** compared to CG ($p = 0.004$; $p = 0.004$, respectively) and SG ($p = 0.004$; $p = 0.004$, respectively). Pathologies such as **dilatation and vacuolization in the distal and proximal tubules, degeneration in glomeruli and an increase in cells tending to apoptosis were observed in kidney tissue. In bladder tissue, degeneration in the transitional epithelium and stromal irregularity and an increase in cells tending to apoptosis were observed in EMRG**. Additionally, EMRG samples **exhibited glomerular capillary degeneration** with capillary basement membranes under TEM. We conclude that **continuous exposure to the effect of 900-MHz EMR for 1 h a day on postnatal days 22-59, inclusive, causes an increase in oxidative stress and various pathological changes in male rat kidney and bladder tissues.**	Rat

Poorer sleep quality, more severe depression and anxiety due to EMR exposure	Bagheri Hosseinabadi M, Khanjani N, Ebrahimi MH, Haji B, Abdolahfard M. Electromagn Biol Med. 2019;38(1):96-101. **The effect of chronic exposure to extremely low-frequency electromagnetic fields on sleep quality, stress, depression and anxiety.**	Investigated the effect of chronic exposure to extremely low-frequency electromagnetic fields on sleep quality, stress, depression and anxiety among power plant workers. The **workers in the exposed group experienced significantly poorer sleep quality** than the unexposed group. **Depression was also more severe in the exposed group** than the unexposed group (P = 0.039). **Increased exposure to ELF-EMR had a direct and significant relation with increased stress, depression, and anxiety**. **Sleep quality in technicians with the highest exposure was significantly lower** than the other groups. This study suggests that **long-term occupational exposure to ELF-EMR may lead to depression, stress, anxiety and poor sleep quality.**	Human
Oxidative stress damage to male and female reproductive systems	Santini SJ, Cordone V, Falone S, Mijit M, Tatone C, Amicarelli F, Di Emidio G. Oxid Med Cell Longev. 2018 Nov 8;2018:5076271. **Role of Mitochondria in the Oxidative Stress Induced by Electromagnetic Fields: Focus on Reproductive Systems.**	**Finding**: A growing body of evidence suggests that EMR exposure during spermatogenesis induces increased ROS production associated with decreased ROS scavenging activity. Numerous studies revealed the **detrimental effects of EMRs** from mobile phones, laptops, and other electric devices on **sperm quality** and provide evidence for **extensive electron leakage from the mitochondrial electron transport chain as the main cause of EMR damage**. In **female reproductive systems, the contribution of oxidative stress to EMR-induced damages** and the **evidence of mitochondrial origin of ROS overproduction are reported**, as well. In conclusion, **mitochondria**	Human

		seem to play an important role as source of ROS in both male and female reproductive systems under EMR exposure. **Action**: Future and more standardized studies are required for a **better understanding of molecular mechanisms underlying EMR potential challenge to our reproductive system in order to improve preventive strategies.**	
Impairment of spatial working memory, delayed motor skills and attention in adolescents exposed to EMR	Meo SA, Almahmoud M, Alsultan Q, Alotaibi N, Alnajashi I, Hajjar WM.Am J Mens Health. 2018 Jan-Feb;13(1):1557988318816914. . **Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health**.	The mobile phone base station towers (MPBST) were located within 200 m from the school buildings. In School 1, RF-EMR was 2.010 µW/cm2 with a frequency of **925 MHz** and in School 2, RF-EMR was 10.021 µW/cm2 with a frequency of **925 MHz**. **Students were exposed to EMRR for 6 hr a day, 5 days a week for a total period of 2 years**.**Significant impairment in Motor Screening Task (**MOT; p = .03) and **Spatial Working Memory (SWM) task (p = .04) was identified among the group of students who were exposed to high RF-EMR produced by MPBSTs**. High exposure to RF-EMR produced by MPBSTs was associated with **delayed fine and gross motor skills, spatial working memory, and attention in school adolescents** compared to students who were exposed to low RF-EMR	Human (children)
Decreased memory performance in adolescents in two separate studies	Foerster M, Thielens A, Joseph W, Eeftens M, Röösli M. **A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication.** EHP Vol 126 (7): 23 Jul 2018 https://doi.org/10.1289/EHP2427	In a previous analysis, we found changes in figural memory scores associated with a higher cumulative RF-EMR brain dose in adolescents. We aimed to follow-up our previous results using a new study population, dose estimation, and approach to controlling for confounding from media	Human (children)

		usage itself. We found **decreased figural memory scores** in association with an interquartile range (IQR) increase in estimated cumulative RF-EMR brain dose scores: -0.22 (95% CI: -0.47, 0.03; IQR: 953 mJ/kg per day) in the whole sample, -0.39 (95% CI: -0.67, -0.10; IQR: 953 mJ/kg per day) in right-side users (n=532), and -0.26 (95% CI: -0.42, -0.10; IQR: 341 mJ/kg per day) when recorded network operator data were used for RF-EMR dose estimation (n=274). Our findings for a cohort of Swiss adolescents require confirmation in other populations but **suggest a potential adverse effect of RF-EMR brain dose on cognitive functions that involve brain regions mostly exposed during mobile phone use.**	
Negative effects on rat and mice fertility	Yang MJ, Lang HY, Miao X, Liu HQ, Zhang YJ, Wang YF, Chen YB, Liu JY, Zeng LH, Guo GZ. Toxicol Res (Camb). 2018 Jul 12;7(6):1120-1127. **Effects of paternal electromagnetic pulse exposure on the reproductive endocrine function of male offspring: a pilot study.**	Male Sprague Dawley rats were randomly **exposed to EMP at 200 kV m-1 for 0, 100 or 400 pulses before mating**. The results showed that paternal exposur**e induced a decrease of testosterone (T), sperm quantity and acrosin activity in the male offspring** ($p < 0.05$). The content of GABA and the protein and mRNA **expression of the hypothalamic GABAA receptor protein increased in the EMP exposure group** ($p < 0.05$). In conclusion, our study shows that under these experimental conditions **EMP had a certain degree of influence on the reproductive endocrine function of the male rat offspring**, and the **hypothalamic GABAA receptor may be involved in the reproductive**	Rat

		toxicity of the male offspring.	
EMR radiation damages male sperm quality	Kesari KK, Agarwal A, Henkel R. Reprod Biol Endocrinol. 2018 Dec 9;16(1):118. **Radiations and male fertility.**	From currently available studies it is clear that radiofrequency electromagnetic fields (RF-EMR) have **deleterious effects on sperm parameters (like sperm count, morphology, motility), affects the role of kinases in cellular metabolism and the endocrine system, and produces genotoxicity, genomic instability and oxidative stress.** The study concludes that the RF-EMR may induce oxidative stress with an increased level of reactive oxygen species, which may lead to infertility. This has been concluded based on available evidences from **in vitro and in vivo studies suggesting that RF-EMR exposure negatively affects sperm quality**.	Human
Increased inflammation and testicular damage by EMR radiation in Wistar rats	Bilgici B, Gun S, Avci B, Akar A, K Engiz B. Int J Radiat Biol. 2018 Nov;94(11):1054-1061. **What is adverse effect of wireless local area network, using 2.45 GHz, on the reproductive system?**	Investigated the inflammatory effect and testicular damage on rats exposed to low level of electromagnetic fields (EMR) at **2.45 GHz microwave radiation**. **Wistar rats** exposed to low level EMR (average E-field 3.68 ± 0.36 V/m, whole body average SAR, 0.0233 W/kg, in 10 g tissue) at **2.45 GHz for 1 hour/day for 30 consecutive days**. **Serum IL-6 and CRP levels were found to be significantly different in the study group** compared to the control group ($p < .05$). Histopathological evaluation of testicular tissue revealed a **significant difference in necrosis and spermatogenesis** when compared with the control group ($p < .05$). **Low level EMR at 2.45 GHz increases inflammation and testicular damage**	Rat

		and negative impact on male reproductive system function.	
Decreased Spermatogenesis in rats exposed to 4G	Oh JJ, Byun SS, Lee SE, Choe G, Hong SK. Biomed Res Int. 2018 Jan 29;2018:1801798. **Effect of Electromagnetic Waves from Mobile Phones on Spermatogenesis in the Era of 4G-LTE.**	Investigated the effect of long duration exposure to electromagnetic field from mobile phones on spermatogenesis in rats using 4G-LTE. The **sum of the germ cell counts was decreased** in Group 4 compared to Groups 1, 2, and 3 ($p = 0.032$). The **mean Leydig cell count was significantly decreased** in Group 4 ($p < 0.001$). The longer exposure duration of electromagnetic field decreased the spermatogenesis. Our findings warrant further investigations on the potential effects of EMR from mobile phones on male fertility.	Rat
Disturbance of reproductive hormone levels and offspring sex ratio by EMRs	Li JH, Jiang DP, Wang YF, Yan JJ, Guo QY, Miao X, Lang HY, Xu SL, Liu JY, Guo GZ. Environ Toxicol Pharmacol. 2017 Sep;54:155-161. **Influence of electromagnetic pulse on the offspring sex ratio of male BALB/c mice.**	Determined whether **paternal exposure to electromagnetic pulse (EMP) affects offspring sex ratio in mice**. 50 male BALB/c mice aged 5-6 weeks were exposed to EMP daily for 2 weeks before mated with non-exposed females at 0d, 7d, 14d, 21d and 28d after exposure. The **serum testosterone increased significantly** in D0, D14, D21, and D28 compared with sham-exposed groups ($p<0.05$). Overall, this study suggested that **EMP exposure may lead to the disturbance of reproductive hormone levels and affect the offspring sex ratio.**	Mice

Negative biochemical, morphological and histological effects of EMR on rat testis	Çetkin M, Kızılkan N, Demirel C, Bozdağ Z, Erkılıç S, Erbağcı H. Andrologia. 2017 Dec;49(10). **Quantitative changes in testicular structure and function in rat exposed to mobile phone radiation.**	**Evaluated the effects of EMR emitted from mobile phones on the rat testis morphology and histopathology** using stereological techniques. We also i**nvestigated cortisol, testosterone, FSH and LH levels**. The **testis weight and volume were significantly lower in the EMR exposed groups**. The mean volume fraction of interstitial tissue was higher, but the volume fraction of **tubular tissue was lower in the EMR-exposed groups**. The **mean tubular and germinal tissue volume, seminiferous tubule diameter and germinal epithelium height were also lower in EMR exposed groups**. The **cortisol levels in the EMR-exposed groups were significantly higher**. In conclusion, the EMR created by mobile phones caused **morphologic and histological changes by the affecting germinal epithelium tissue negatively.**	Rat
Cellular damage by EMRs in rat ocular cells	Eker ED, Arslan B, Yildirim M, Akar A, Aras N. Bratisl Lek Listy. 2018;119(9):588-592. **The effect of exposure to 1800 MHz radiofrequency radiation on epidermal growth factor, caspase-3, Hsp27 and p38MAPK gene expressions in the rat eye.**	Investigated the expression levels of heat shock protein 27 (Hsp27), p38 mitogen-activated protein kinase (p38MAPK), epidermal growth factor receptor (EGFR) and caspase-3 gene expression levels in rat eye that was exposed to 1800 MHz RF-EMR. The rats in the study group (n = 9) were **exposed to 1800 MHz RF-EMR at an electric field 6.8 ± 0.1 V/m and 0.06 W/kg specific absorption rate (SAR) for 2 hours per day for eight weeks**. **caspase-3 and p38MAPK gene expression were significantly upregulated in the ocular tissues following exposure to RF-EMR** ($p < 0.05$). According to our findings, **eye cells recognize EMR**	Rat

		as a stress factor, and in response, activate caspase-3 and p38MAPK gene expressions. These results confirm that **RF-EMR can cause cellular damage in rat ocular cells.**	
Oxidative stress and apoptosis caused by EMR is reduced by adding Selenium to human embryonic kidney cells	Pastacı Özsobacı N, Düzgün Ergün D, Durmuş S, Tunçdemir M, Uzun H, Gelişgen R, Özçelik D. J Trace Elem Med Biol. 2018 Dec;50:572-579.. **Selenium supplementation ameliorates electromagnetic field-induced oxidative stress in the HEK293 cells.**	Investigated the effect of Se on **2.4 GHz frequency EMR exposed human embryonic kidney cells (HEK293) by means of alterations in apoptotic and oxidative stress parameters**. EMR groups were exposed to 2.4 GHz EMR for 1 h, element groups were incubated with two different doses of Se added cell culture medium for 48 h before EMR exposure. **MDA levels were significantly higher whereas SOD and GSH-Px activities were significantly lower in EMR c**ompared to control. 100 and 200 nM Se + EMR application decreased MDA levels, increased SOD and GSH-Px activities than EMR. Apoptosis and caspase-3 were statistically significantly higher but bcl-2 was lower in EMR than control. Apoptosis and caspase-3 were lower in 100 and 200 nM Se + EMR, although bcl-2 were higher than EMR. In conclusion, **Se has protective effects against 2.4 GHz EMR-induced oxidative stress by reducing lipid peroxidation**, regulating SOD and GSH-Px activity. Also, **Se has inhibitory effect on 2.4 GHz EMR induced apoptosis** by increasing the expression of anti-apoptotic protein bcl-2 and suppressing apoptosis regulatory protein caspase-3.	Human Cell line

Wi-Fi EMR radiation at 2.45GHz is damaging to health causing multiple negative effects which are likely to affect young people more than adults.	Pall ML. Environ Res. 2018 Jul;164:405-416. . **Wi-Fi is an important threat to human health.**	Wi-Fi causes **oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload.** Each of these seven effects is also produced by downstream effects of the main action of such EMRs, voltage-gated calcium channel (VGCC) activation. F**ive properties of non-thermal EMR effects are discussed. These are that pulsed EMRs are, in most cases, more active than are non-pulsed EMRs; artificial EMRs are polarized and such polarized EMRs are much more active than non-polarized EMRs; dose-response curves are non-linear and non-monotone; EMR effects are often cumulative; and EMRs may impact young people more than adults.** There are seven repeatedly found Wi-Fi effects which have also been shown to be caused by other similar EMR exposures.	Human
Negative EMR impact on chick embryo development - heart weight and wall thickness reduced, increase in corticosterone levels indicating EMR causes stress	Pawlak K, Nieckarz Z, Sechman A, Wojtysiak D, Bojarski B, Tombarkiewicz B. Anat Histol Embryol. 2018 Jun;47(3):222-230. **Effect of a 1800 MHz electromagnetic field emitted during embryogenesis on chick development and hatchability**.	Determined the effect of a **1800 MHz electromagnetic field during embryogenesis on the frequency of chick embryo malformations**, **morphometric parameters of the heart and liver and concentration of corticosterone in blood plasma, lipid and glycogen content in the liver of newly hatched chicks.** Exposure of chick embryos to EMR c**aused decreases in relative heart weight and right ventricle wall thickness**. The pipping and hatching of chicks can be accelerated by stressful impact of EMR, which is	Chicken

		confirmed by a **significant increase in plasma corticosterone concentrations and decrease in fat and glycogen in the liver of chicks exposed during embryogenesis** on the electromagnetic field with a frequency of 1800 MHz.	
Altered female porcine uterine oestrogen hormone secretion due to EMRs	Koziorowska A, Waszkiewicz EM, Romerowicz-Misielak M, Zglejc-Waszak K, Franczak A. Theriogenology. 2018 Apr 1;110:86-95. **Extremely low-frequency electromagnetic field (EMR) generates alterations in the synthesis and secretion of oestradiol-17β (E2) in uterine tissues: An in vitro study.**	Determined the effect of an **EMR on the synthesis and secretion of oestradiol-17β (E2) in the porcine uterus.** Endometrial and myometrial slices were harvested on days 12-13 of the oestrous cycle and exposed in vitro to an EMR (50 and 120 Hz, 8 mT) for 2 and 4 h in the presence or absence of progesterone (P4). In conclusion, the **EMR induces changes in the synthesis and release of E2** in uterine tissues harvested during days 12-13 of the oestrous cycle. These **changes are related to the EMR frequency used, the time of the exposition and the presence of P4.** We suspect that this observed phenomenon might lead to **changes in the intrauterine milieu of oestrogen, which is crucial for the proper activity of uterine tissues during the mid-luteal phase of the oestrous cycle.**	Pigs
Sciatic nerve damage in Male rats due to EMRs	Kerimoğlu G, Güney C, Ersöz Ş, Odacı E. J Chem Neuroanat. 2018 Sep;91:1-7. **A histopathological and biochemical evaluation of oxidative injury in the sciatic nerves of male rats exposed to a continuous 900-megahertz electromagnetic field throughout all periods of adolescence.**	Sprague Dawley rats (EMRGr) aged 21 days were exposed to the effect of a **900-megahertz (MHz) EMR for 1 h at the same time every day between postnatal days 21-59** (the entire adolescent period) inside a cage in the EMR apparatus. There was **marked thickening in the epineurium of sciatic nerves** from EMRGr rats. **MDA, SOD and CAT levels were higher in EMRGr** than in CGr and SGr at biochemical	Rat

		analyses. Apoptotic index (AI) analysis revealed a **significant increase in the number of TUNEL (+) cells when EMRGr was compared with CGr and SGr.** In conclusion, our study results suggest that **continuous exposure to a 900-MHz EMR for 1 h throughout adolescence can cause oxidative injury and thickening in the epineurium in the sciatic nerve in male rats.**	
Memory impairment by EMRs from mobile phones (MP)	Kalafatakis F, Bekiaridis-Moschou D, Gkioka E, Tsolaki M Hell J Nucl Med. 2017 Sep-Dec;20 Suppl:146-154. **Mobile phone use for 5 minutes can cause significant memory impairment in humans.**	**Healthy participants of the experimental group performed worst in the memory task after using the MP**. The **reduction of the performance** in the task after using the MP was **even higher for the age group of 60-80 years old** in comparison with younger age groups, as well as for the individuals with MCI in comparison to healthy participants. **Age was significantly negative correlated with performance in the task**, while gender showed no significant correlation. **MP use has a significant negative impact on working memory performance** of human participants. The effect is apparent even for a 5 minute use of the MP. Working memory deficits are greater not only for the 60 years old and above participants but also for individuals with Mild Cognitive Impairment. **These results are in agreement with previous studies on animals as well as humans on the effects of MP use on the brain**. It is concluded that the **development of certain restrictions on MP use is necessary for the protection of the brain health of the users.**	Human

EMRs cause autophagy as a stress response in the hippocampus of mice	Kim JH, Yu DH, Kim HJ, Huh YH, Cho SW, Lee JK, Kim HG, Kim HR. Toxicol Ind Health. 2018 Jan;34(1):23-35. Exposure to 835 MHz radiofrequency electromagnetic field induces autophagy in hippocampus but not in brain stem of mice.	Explored **whether autophagy is triggered in the hippocampus or brain stem after RF-EMR exposure**. C57BL/6 mice were exposed to **835 MHz RF-EMR** with specific absorption rates (SAR) of 4.0 W/kg for 12 weeks. **Several autophagic genes**, which play key roles in autophagy regulation, were **significantly upregulated only in the hippocampus** and not in the brain stem. **Expression levels of LC3B-II protein and p62, crucial autophagic regulatory proteins, were significantly changed only in the hippocampus.** In parallel, transmission electron microscopy (TEM) revealed an **increase in the number of autophagosomes and autolysosomes in the hippocampal neurons of RF-EMR-exposed mice**. The present study revealed that **autophagy was induced in the hippocampus**, not in the brain stem, in 835 MHz RF-EMR with an SAR of 4.0 W/kg for 12 weeks. These results could suggest that among the various adaptation processes to the RF-EMR exposure environment, **autophagic degradation is one possible mechanism in specific brain regions.**	Mice
EMRs decrease beta-adrenoceptor function in red blood cells of turkeys	Laszlo AM, Ladanyi M, Boda K, Csicsman J, Bari F, Serester A, Molnar Z, Sepp K, Galfi M, Radacs M Poult Sci. 2018 Feb 1;97(2):634-642. **Effects of extremely low frequency electromagnetic fields on turkeys.**	For monitoring the effects of ELF EMR, we used a turkey (Meleagris gallopavo) model, because the nucleated erythrocytes of turkeys contain β-adrenoceptors, and **norepinephrine- (NE-) activated β-adrenoceptors have an important role in physiological and behavioral processes**. The turkeys in the treatment group were treated in vivo with ELF	Turkeys

		EMR **(50 Hz; 10 μT) for 3 wk after a 1-wk-long adaptation period**. The animals were not exposed to ELF EMR during the regeneration period (5 wk following the exposure). **NE-activated β-adrenoceptor function was decreased in the treated birds in a time-dependent manner.** The decreased NE-dependent β-adrenoceptor function could be compensated by the homeostatic complex during the 5-wk regeneration period. Extended experimental periods and more sophisticated analysis methods may help prevent harmful environmental effects on birds; furthermore, these findings could affect public health and the economy.	
EMR continuous and intermittent exposure causes significant disturbances in the levels of copper and magnesium in serum and various tissues from guinea pigs	Erdem O, Akay C, Cevher SC, Canseven AG, Aydın A, Seyhan N. Biol Trace Elem Res. 2018 Feb;181(2):265-271. **Effects of Intermittent and Continuous Magnetic Fields on Trace Element Levels in Guinea Pigs.**	Guinea pigs were exposed to a magnetic field of **50 Hz of 1.5 mT.** Groups A and B were exposed to the magnetic field for a period of 4 h/day continuously (4 h/day) for 4 and 7 days, respectively. Groups C and D were exposed to the magnetic field for a period of 4 h/day intermittently for 4 and 7 days, respectively. Group E animals were enrolled as control. Copper (Cu), zinc (Zn), calcium (Ca), and magnesium (Mg) levels were determined by atomic absorption spectroscopy in serum, femur, brain, kidney, and liver tissues in all guinea pigs. **Changes in the levels of Cu in serum samples, femur, and kidney tissues of the treated groups were statistically significant.** The **same was also true for the levels of Mg in the brain, kidney, and lung tissues.** Our results suggest that **in vivo continuous and intermittent exposure to EMR may cause**	Guinea pigs

		disturbances in homeostasis of bioelements. These effects could be important risk factors for toxic effects of EMR, especially in relation to deterioration of bioelements.	
Nerve damage and hyperactivity caused by EMRs in mice	Kim JH, Yu DH, Huh YH, Lee EH, Kim HG, Kim HR. Sci Rep. 2017 Jan 20;7:41129. **Long-term exposure to 835 MHz RF-EMR induces hyperactivity, autophagy and demyelination in the cortical neurons of mice.**	Studied neuronal effects of **RF-EMR on the cerebral cortex of the mouse brain as a proxy for cranial exposure during mobile phone use**. C57BL/6 mice were exposed to **835 MHz RF-EMR at a specific absorption rate (SAR) of 4.0 W/kg for 5 hours/day during 12 weeks.** They found that RF-EMR exposure led to **myelin sheath damage and mice displayed hyperactivity-like behaviour.** The data suggest that **autophagy may act as a protective pathway for the neuronal cell bodies in the cerebral cortex during radiofrequency exposure**. The observations that neuronal cell bodies remained structurally stable but **demyelination was induced in cortical neurons following prolonged RF-EMR suggests a potential cause of neurological or neurobehavioural disorders.**	Mice
Eight plant species are very sensitive to EMRs showing physiological and morphological effects	Halgamuge MN. Plant physiological and morphological sensitivity to EMRs Electromagn Biol Med. 2017;36(2):213-235. **Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants.**	Looked at 169 experimental observations to detect the physiological and morphological changes in plants due to the non-thermal RF-EMR effects from mobile phone radiation. Twenty-nine different species of plants were considered in this work. Find that data from a	Plants

		substantial amount of the studies on RF-EMRs from mobile phones show **physiological and/or morphological effects** (89.9%, $p < 0.001$). Following plants - **maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMRs.** Our findings also suggest that **plants seem to be more responsive to certain frequencies**, especially the frequencies between (i) 800 and 1500 MHz ($p < 0.0001$), (ii) 1500 and 2400 MHz ($p < 0.0001$) and (iii) 3500 and 8000 MHz ($p = 0.0161$). None of these findings can be directly associated with human; however, on the other hand, this cannot be excluded, as **it can impact the human welfare and health, either directly or indirectly, due to their complexity and varied effects (calcium metabolism, stress proteins, etc.).** This **study should be useful as a reference for researchers conducting epidemiological studies and the long-term experiments, using whole organisms, to observe the effects of RF-EMRs.**	
Reduction in growth, weight, water content, increase in membrane damage and antioxidant activity in mung bean and wheat seedlings due to cell phone EMR	Afzal, M. and Mansoor, S. (2012) Asian Journal of Agricultural Sciences 4(2): 149-152. **Effect of Mobile Phone Radiations on Morphological and Biochemical Parameters of Mung Bean (Vigna radiata) and Wheat (Triticum aestivum) Seedlings**	Observed the **morphological and biochemical changes induced by cell phone radiations on Mung bean (Vigna radiata) and Wheat (Triticum aestivum) seedlings.** Our results showed that **cell phone EMR caused significant reduction in growth, fresh weight, dry weight, and relative water contents. Melondialdehyde [MDA] contents and changes in the levels of antioxidant enzymes like Guaiacol**	Plants

		Peroxidase (GPX), Ascorbate Peroxidase (APX), and Catalase (CAT) were increased in stressed seedlings as compared to unstressed seedlings. We concluded that **radiations emitted by mobile phone can induce oxidative stress which results in reduced growth and increase in the activity of antioxidant enzymes in mung bean and wheat seedlings.**	
Tadpole deaths fue to EMRs from phone masts	Balmori A. Electromagn Biol Med. 2010 Jun;29(1-2):31-5. **Mobile phone mast effects on common frog (Rana temporaria) tadpoles: the city turned into a laboratory.**	Exposed eggs and tadpoles of the common frog (Rana temporaria) to electromagnetic radiation from several mobile (cell) phone antennae located at a distance of 140 meters. In the exposed group (n = 70), **low coordination of movements, an asynchronous growth, resulting in both big and small tadpoles, and a high mortality (90%) was observed.** Regarding the control group (n = 70) under the same conditions but inside a Faraday cage, the coordination of movements was normal, the development was synchronous, and a mortality of 4.2% was obtained. These results indicate that **radiation emitted by phone masts in a real situation may affect the development and may cause an increase in mortality of exposed tadpoles.** This research may have **huge implications for the natural world, which is now exposed to high microwave radiation levels from a multitude of phone masts.**	Frogs

Table 4: Comparison of EMR Safety Standards compiled from Naren *et al*. 2020 [23]

Standard	Technology Type	Reference value for public exposure / $\mu W/m^2$	Upper band Frequency	Concern level
ICNIRP standard	1G	4,000,000	800 MHz	No concern
ICNIRP standard	2G	9,500,000	1900 MHz	No concern
ICNIRP standard	3G	10,000,000	2100 MHz	No concern
ICNIRP standard	4G	10,000,000	2.6 GHz	No concern
ICNIRP standard	Wi-Fi	10,000,000	2.5 GHz	No concern
ICNIRP standard	Bluetooth	10,000,000	5 GHz	No concern
Building Biology Standard /	2G-4G, Wifi & Bluetooth	<1	800 GHz - 5 GHz	No concern
Building Biology Standard	2G-4G, Wifi & Bluetooth	1-10	800 GHz - 5 GHz	Slight concern
Building Biology Standard	2G-4G, Wifi & Bluetooth	10-1000	800 GHz - 5 GHz	Severe concern
Building Biology Standard	2G-4G, Wifi & Bluetooth	>1000	800 GHz - 5 GHz	Extreme concern
Austrian Medical Association (AMA)	2G-4G, Wifi & Bluetooth	<1	800 GHz - 5 GHz	Within normal limits
Austrian Medical Association (AMA)	2G-4G, Wifi & Bluetooth	1-10	800 GHz - 5 GHz	Slightly above normal
Austrian Medical Association (AMA)	2G-4G, Wifi & Bluetooth	10-1000	800 GHz - 5 GHz	Far above normal
Austrian Medical Association (AMA)	2G-4G, Wifi & Bluetooth	>1000	800 GHz - 5 GHz	Very far above normal

Table 5: Safety Recommendations for Portable Devices Emitting EMF radiation from Naren *et al*. 2020 [23]

Device Type	Recommendations
Cell Phones / Smartphones on Cellular Networks	1. **Network**: For internet connectivity, prefer Wi-Fi. If not available prefer to use 4G networks for both calling and browsing/ data streaming. 2. **Calling**.: Use wired headphones and keep the phone at least 1m away while calling. 3. **Browsing / Video Streaming**: Keep device on a table / platform at least 50 cm away
Wi-Fi Devices	1. Prefer smartphones over laptops for casual work such as emails/ browsing. 2. Keep smartphone / laptop on a table and operate from an arm's distance. 3. Avoid keeping a smartphone in the pocket while it is connected to a Wi-Fi router. 4. Avoid keeping laptop on the lap while it is connected to a Wi-Fi router. 5. Wireless (Adhoc transfer): Stay at least 1m away from both sender and receiver. 6. 4G wireless hotspot: Stay at least 2m away from the device while it is active.
Bluetooth Devices	1**. Speakers**: Keep speakers at least 25cm away and connected smartphones at least 50cm away. 2. **Smartwatch** : Avoid unless absolutely necessary. 3. **Earphones**: Avoid unless absolutely necessary.

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5.0 Appendix

Objection letter Template

Objection by XXXXX to 5G mast XXXX Road, Suburb name, City Name, Post Code (Application Number: XXXX/YYYY/PA)

I would like to **object strongly** to the installation of a 5G mast on XXXX Road, Suburb name, City Name, Post Code, for the following reasons:

1. Key scientific literature points to **very real, non-thermal negative biological effects of electromagnetic radiation (EMR)** which is being ignored by the mobile and broadband industry as well as bodies like the ICNIRP. Our government relies upon the PHE, which in turn relies on the ICNIRP, to give us guidance regarding the safety of 5G.
2. These negative non-thermal biological effects occur as a direct result of **extremely low EMR levels**, (2-10 $\mu W/cm^{2)}$) which are several orders of magnitude lower than the current safety limits (10,000,000 $\mu W/m^2$) set by ICNIRP. Ofcom's published results [23] at 5G sites (1.5% of 10,000,000 $\mu W/m^2$ for 3G-5G) and (0.039% of 10,000,000 $\mu W/m^2$ for 5G only) still equate to **150,000 fold higher and 3,900 fold higher** than the safe levels (<1 $\mu W/m^2$) set by the Building Biology and Austrian Medical Association standards which don't ignore the above negative effects.
3. Cornerstone quote the Stewart report (updated in 2010), saying the evidence did not suggest that exposures to EMR below international guidelines could cause adverse health effects. They state that they adhere to the Stewart report and ICNIRP rules, but since 2010, there have been many publications **pointing to actual harm of EMRs on children's health by mobile base stations** – e.g. Meo et al (2018) [22] studied exposure of adolescents at 2-10 mW/cm^2 EMR exposure from a mobile base station 200 metres from a school and this resulted in **impairment of spatial working memory and attention, and delayed motor skills.** They state that mobile base stations should be '***installed away from thickly populated residential zones*** *particularly in or near the school buildings or there must be some system to shield human beings from RF-EMFR'*.
4. The planned 5G mast at Suburb name, City Name, Post Code is within 150 metres to XXXX school where children will be studying and will be exposed to **untested frequencies** of 5G EMR **which is dangerous**.
5. **Wireless carriers have conceded** to U.S. Senator Richard Blumenthal that they are **not aware of any independent scientific studies on the safety of 5G technologies.** [7]
6. Safer **underground fibre optic wired technology** has already been used for **Northumberland County Council and National Parks England** – we should be doing the same for the safety of our children and the public. [24] ***Lower cost 5G masts should not be installed at the expense of damaging our health.***
7. The current plans for the roll out of 5G are **misguided** by Public Health England (PHE) which relies entirely on ICNIRP safety guidelines on EMRs which have been shown to be **deeply flawed** – see Pall, M. (2018) [1] ,Hardell & Nyberg (2020) [3], Naren et al. (2020) [15], and Hertsgaard & Dowie (2018) [13] .
8. The ICNIRP safety guidelines are **flawed** because:
    a. They **assume average EMR intensities and average SAR** can be used to predict biological effects and therefore safety. In fact, negative non-thermal biological effects occur approximately 100,000 times below current allowable levels.
    b. They **ignore demonstrated biological heterogeneity** and established biological mechanisms
    c. They **ignore pulsed EMRs which are much more biologically active than are non-pulsed** EMRs of the same average intensity
    d. They **ignore complex sinusoidal dose-response curves**

e. They also **ignore many important scientific reviews which show non-thermal negative biological effects** caused by EMRs
f. There are many articles which state **that EMRs produce diverse non-thermal effects through voltage gated calcium channels (VGCCs) in cells and produce negative biological effects such as oxidative stress, cellular DNA damage and increased calcium signalling** but the voltage sensor of the VGCC is ignored by the 2020 ICNIRP safety guidelines. (see the following articles for which Pall,M. 2018 (1) & Doyon PR et al, (2017) [(4)] Herbert MR & Sage C (2013) [(9)] ,Panagopoulos et al (2002) [(10)] .

9. **Negative non-thermal biological effects of electromagnetic radiation** listed in the literature across humans and other species are : (see References below from Pall (2018) [(1)])
    a. Lowered adaptive immune responses or immune system dysregulation
    b. Cardiac effects, including tachycardia, bradycardia and arrythmias, and ventricular developmental defects
    c. Cancer including initiation, promotion and progression (Morgan et al 2015) (18)
    d. Pathological damage to multiple organs (e.g. liver, kidneys, uterus, bladder, testis)
    e. Trace element disturbances in tissues
    f. Ocular damage
    g. Lowered fertility
    h. Hormonal dysregulation
    i. Neurological / neuropsychiatric effects
    j. Sleep disruption
    k. Memory, motor skill, attention, cognition impairment
    l. Apoptosis / programmed cell death
    m. Oxidative stress / free radical damage
    n. Single strand and double strand breaks in cellular DNA
    o. Increased intracellular calcium levels causing chronic effects
10. Therefore, **many scientists globally have asked for a moratorium on the deployment of 5G** until the electromagnetic radiation risks associated with this new emerging technology have been fully investigated by industry-independent scientists, but this is falling on deaf ears. The responses from the EU seem to have thus far **prioritized industry profits to the detriment of human health and the environment**. Hardell & Nyberg (2020) [(3)]
11. This means that the current situation in the United Kingdom is a **violation of Human Rights** similar to that which has been tabled to the United Nations Human Rights Council in early 2019 for Australia by S.J. Toneguzzo. (See https://www.radiationresearch.org/wp-content/uploads/2019/03/pace-UN-Human-Rights-Council-5G-statement.pdf)
12. The **deployment of 5G without safety testing in the UK violates over 15 international agreements, treaties and recommendations,** including article 7 of the International Covenant on Civil and Political Rights and principle 9 of the Declaration of Helsinki of 1964. (see links as follows: https://treaties.un.org/doc/publication/unts/volume%20999/volume-999-i-14668-english.pdf and https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/
13. Clearly if existing low level EMRs are having damaging biological responses such as those listed in point 5 above, surely untested frequencies such as 5G, should mean that we should **be invoking the precautionary principle on 5G, and re-evaluating and revising current safety limits, as well as putting a moratorium on the roll out of 5G**? Naren et al. (2020) [(15)] have stated that 5G should only be deployed after having safety testing, as the EMR exposure levels they see with 2-4G are well over the safe limits set by Building Biology, Austrian Medical Association, and the BioInitiative standards which do take into account non-thermal negative biological EMR effects. Also the denser networks needed to support 5G will

mean that the **unsuspecting public will be exposed to continuously higher levels of electromagnetic radiation indoors and outdoors.**

14. The **precautionary principle has already been applied** by multiple local city councils in England (Brighton, Hove, Devonshire, Shepton Mallet, Somerset, Frome, Totnes, Wells, Glastonbury, Trafford) as well as other rightly concerned countries like Nigeria, Slovenia, etc. – see URL links 5 and 6 in References for a full list.
15. Central Government should not be dictating to local planning authorities and contending with them to insist that they "**not seek to determine the health safeguards of the planning proposal**" (paragraph 116 of the National Planning Policy Framework) and whether the ICNIRP guidelines for public exposure are deeply flawed. Scientists world-wide have been writing to governments for years now asking them to revise the safety guidelines of wireless exposure for the public, as they know it is harmful to the health of not just humans, but also other species in our ecosystem. This is **interfering with local planning authority decision making, authority and independence** in choosing outcomes that are best for its people and community.
16. We should be insisting that **adequate safety testing is done for 5G**, and that **current safety limits are re-evaluated** in the light of the overwhelming body of current scientific literature which points to non-thermal negative biological responses across multiple species, not just human beings. (see reference 8) Naren et al. (2020) [(15)] state that "If 5G networks are deployed without careful analysis of expected exposure levels, almost all people in the area of coverage may be exposed to dangerous levels of power flux density, the outcomes of which, in the near future, may turn out to be **calamitous**."
17. Only after safety testing of 5G had been done by the mobile and broadband industry and by independent non-industry scientists who have no economical allegiance or scientific bias towards such emerging technology, should 5G have even be considered to be deployed in the UK. Any such safety testing data needs to **be independently verified by a non-industry scientific committee** (ISC -see below for composition).
18. We should be **consulting and informing constituents of their rights in those parts of the UK, for whom 5G has been rolled out,** without safety testing, as well as putting a halt to access to 5G, until we are aware of the full impact of 5G on, not just humans, but also on all species. This is because we now know that existing low level EMRs, is already damaging humans as well as less complex species such as plants, insects, birds and lower mammals (see References below and Naren et al. (2020) [(15)]).
19. Having assessed the latest data on EMR (see References section below) we should be trying to:
    a. protect our public from harmful EMR by doing safety testing of 5G
    b. prioritise/incentivise the use of safer wired fibre optic solutions in our homes, shopping centres, airports, hospitals, workplaces and schools
    c. encourage families to protect their future generations by minimising the use of portable devices (mobile phones, tablets, laptops) (see letter requesting the same in reference 8 below)
    d. suggest urgent research on the safety and efficacy of shielding methods combined with use of generators emitting weak pulses of similar frequency, intensity, and waveform with the natural atmospheric resonances - Panagopoulos & Chrousos (2019) [(10)]
    e. understand the molecular mechanisms underlying the EMR potential challenges to multiple biological systems, to improve preventive strategies - Santini et al. (2018) [(11)]
    f. put in place mobile and broadband industry-independent safety and usage regulations to protect our public and all species
    g. advise appropriate restrictions on the use of EMR emitting mobiles and all portable devices in order to protect the health of all users, i.e. not with respect to only one

organ but with respect to our bodies as a whole, as well with respect to the health of the delicate ecosystem around us.

20. Barnes & Greenebaum (2020) [16] state that we don't yet know whether biological effects seen due to lower level, long term EMR exposure are resulting in medical problems for a much larger number of people. Therefore, governments need to investigate long-term exposure to weak EMRs, and put in place safety guidelines to address this issue.

    I strongly urge the council to:

    i. use an independent scientific committee to re-evaluate the body of scientific evidence on extremely low EMRs (continuous and pulsed)
    ii. put a moratorium on the roll out of future 5G installations until adequate safety data is available
    iii. decommission the operation of existing 5G installations until safety testing has been verified and approved by not just the mobile and broadband industry but by a non-industry working group of scientists, physicians and members of the public who can assess the data independent of 5G manufacturers
    iv. contact the public in any area where 5G is going to be deployed or already deployed and ask them if they still want to have the greater connectivity of 5G despite the potential long term harms associated with exposed to very high levels of power flex density emitted by 5G EMR. Leave the choice to the public, and where they still want access, ensure that 5G is made available **only through wired fibre optic technology** thereby protecting us all
    v. take action now for all those persons with Electromagnetic Hypersensitivity (EHS) where they have been already subjected to 5G to inform them that the existing 5G masts will be decommissioned and a wired fibre optic technology solution put in to replace 5G masts
    vi. to take action to immediately to rectify masts that are close to residential buildings and schools which should be protected from close by sources of EMR.

Not everyone in every community in this country needs or wants superfast broadband / mobile connectivity. Individual connectivity needs are different across this country. 5G roll out should only ever have been considered after appropriate safety testing had been completed by the mobile and broadband industry as well as independent scientific bodies and after consultation with people in this democratic country as to its downstream health, economic and sociological impact on our future overall wellbeing.

If gigabit connectivity is necessary for particular industries, the council needs to ensure that it doesn't compromise the safety, health and wellbeing of people, where lower speed connectivity is sufficient for a given community. Where gigabit connectivity has to be installed for functional and economic reasons, they should remove long term EMR exposure of all constituents in that area, by using wired fibre optic solutions, which protects populations from chronic and possibly acute diseases. Naren et al. (2020) state: "The carcinogenic nature of EMR which results in mutation of sperm cells as well as testicular cancer has also been reported. Thus, the probability that future generations will inherit unhealthy or low-immunity genes is also increased." This has a massive impact on residential areas and schools.

The literature shows the existence of damaging outcomes to multiple reproductive systems both human (Santini et al 2018) and other species like rat (Yang et al 2018 [20]) and mice (Li et al 2017 [21]), by EMR, backing up Naren et al. (2020) [15] in their prediction that future generations are most at risk.

Both Pall (2018) [19] and Wilke (2018) [12] advocate getting rid of Wi-Fi in schools to protect future generations as well as teachers from EMR damage. Santini et al. (2018) [11] after showing oxidative stress effects of EMR in male and female reproductive systems urge that we should be aiming to get "a better understanding of the molecular mechanisms underlying EMR potential challenge to our reproductive system in order to improve preventive strategies."

Affected residents near 5G masts should be informed about scientific data that points to negative non-thermal biological responses to pulsed electromagnetic radiation, and that existing 5G has had no safety testing. Existing installations should be decommissioned until further notice, and future 5G roll outs halted, until adequate safety testing has been conducted. Deployed installations of 5G are probably already having a direct, negative, cumulative effect on the short term and long term health of the UK public.

Government, PHE, AGNIR, HPA, local authorities and Ofcom need a rethink of how they assess the safety, ethics and use of not just mobile and broadband technologies. They heavily rely on a non-independent body (ICNIRP) for their safety guidelines on current EMR limits and are too heavily reliant on segregated government bodies and the mobile and broadband industry, for their understanding of EMR emitting emerging technologies. Members of the public should be used as independent scrutinisers in order for government to be held accountable to ensure that they are indeed acting in the best interests of all of the UK population.
https://www.gov.uk/government/publications/radiofrequency-electromagnetic-fields-health-effects/health-protection-agency-response-to-the-2012-agnir-report-on-the-health-effects-from-radiofrequency-electromagnetic-fields

"AGNIR's main conclusion is that, …there is no convincing evidence that RF field exposures below guideline levels cause health effects in adults or children." AGNIR concludes there is increasing evidence that RF fields below guideline levels do not cause symptoms and cannot be detected by people, even those who consider themselves sensitive to RF fields. HPA agrees with AGNIR that this does not undermine the importance of the symptoms that are experienced, but it does suggest causes other than those directly related to RF fields should be considered."

As long as the health governing bodies that advise the government and the council, like the PHE, AGNIR, HPA, and Ofcom are **blinded by the flawed guidelines of the ICNIRP**, and not bothering to look at actual biological data that is in Entrez Pubmed (a scientific database containing peer reviewed articles), our council too, will continue to make **misguided decisions**.

Government and councils need to understand that **real scientists are speaking out** to alert them of the dangers of EMR to the public. They need to stop allowing industry to upgrade mobile and digital technology **without doing adequate safety checks and without consulting the public**. This is the case, especially when it comes to wireless connectivity, which involves exposure of the unaware public, of just how damaging low level EMR is, to humans, as well as all species. **There is enough data out there now, for the UK government and local city councils to be held accountable for blinded decisions.**

The PHE, AGNIR or HPA are not independently assessing the scientific data, or they would have come to the conclusion that **low level EMRs are having a direct, visible, detectable, measurable and negative biological impact on multiple species not just humans**, which needs to be understood and managed safely, rather than allowing the mobile and broadband industry to upgrade to more penetrating and more pervasive digital technologies like 5G. 5G base stations will be more dense in the network, exposing the public to several fold higher and continuous EMR than before, (see Naren et al 2020 [15]) without any safety data.

Councils need to be aware that due to the base station density required for 5G to be effective, the UK public will be exposed to 60GHz frequencies of EMR indoors and outdoors with no chance of ever

being able to switch it off. This is dangerous and all the scientific peer reviewed data for 2G-4G frequencies (1900 MHz – 2.6GHz) is already pointing to **damaging biological effects for frequencies of electromagnetic radiation from existing digital sources**. It is important when scientists worldwide, are calling for a moratorium, on the roll out of 5G, for reasons that lower frequencies than 5G are already causing negative biological responses, **that questions should be asked** of government, local authorities, Ofcom and the mobile and broadband industry, by an independent scientific committee.

We know that already deployed EMR at lower frequencies than 5G has negative effects on our physical wellbeing, and exposure to these frequencies is having a negative effect on future generations.

Barnes & Greenebaum (2020) [(16)] believe a carefully targeted program of research funds is called for, from both governmental and private entities that emit RF signals to elucidate and define threshold signal levels for the generation of long-term biological effects.

If a body such as the ICNIRP displays any scientific bias when assessing the biological impact of emerging EMR technologies such as 5G from the mobile and broadband sectors, without adequate concern for public health, this results in **misguided policy making** by this government and councils, which will result in definite harm to our UK population.

MP's, Mayors, PHE and planning committees need to use **joined up thinking** with respect to the public's concerns of how and where and what 5G / gigabit installations are implemented. Mayors, MP's, PHE, Ofcom, planning committees and local city council digital teams should **all work together to resolve matters of safety and public welfare** – be they regarding our health, economic, sociological or environmental welfare. Each of these bodies need to be **accountable** and have a good understanding of the impact of their decisions regarding emerging technologies and their impact on existing and future generations as well as our environment. Currently, they seem to be **passing the buck from one government department to the other**, instead of taking ownership of the problem.

The disregard of the ICNIRP of important scientific data on EMR harms, has resulted in the current situation in the UK where current PHE safety guidelines used by this government are deeply flawed, and unfortunately **reams of peer reviewed scientific data pointing to very real negative biological responses to EMR, in humans and other species, have been ignored**. This problem can only be resolved by concerned scientists speaking out, to highlight current **misguided decisions by government stakeholders**, without truly considering independent science which has been shouting to the tree tops, that the global health of humans and other species is being **damaged by rampant and ever increasing electromagnetic radiation**.

The UNESCO 2005 Precautionary Principle (PP) [(14)] states: "Companies need to become partners with the public and the administration, and they thus need to adopt a principled attitude of transparency and knowledge sharing….Yet, precaution typically involves public consultations, deliberations and hearings that may focus on selected side effects or possible harms.

The roll out of 5G has not had any address to the public of its safety. There is no scientific safety data which has been scrutinised by independent parties regarding 5G being a good solution for better and safer connectivity.

There has been no attempt by the companies that have rolled out 5G to become 'partners with the public.' In fact the public are mainly **unaware of the safety data around 5G**, they have **not been involved in its roll out**, and there has been **no deliberations involving the public** in the UK that have addressed **side effects or possible harms**. In fact the Precautionary Principle has been **completely ignored with respect to 5G roll out**. This needs to be **addressed urgently** by the government and councils.

Much of the scientific evidence is pointing to deep concern regarding the dangers of 5G to our human population as well as even greater danger to delicate smaller mammals, birds and insects which "will be heavily impacted because of their large surface to volume ratios. The same thing will be true of plants where even large trees have their leaves and reproductive organs highly exposed." Pall 2019 (2) This is because the type of radiation that 5G consists of, is the type where due to its "**low penetration and very high energy deposition per unit distance**, this can lead to generation of high levels of free radicals in a short distance which in turn increases the risk of skin cancer." Mortazavi & Mehdizadeh (2019) [(17)].

Naren et al (2020) [(15)] state: "5G is set to use frequencies between **30 GHz and 100 GHz and would have a bandwidth of 60 GHz, which is much higher than all previous generations**. Owing to the increased frequency, the wavelengths in 5G communications will be in the order of few millimeters. Shorter wavelengths travel shorter distances; therefore, 5G networks will **be much denser compared to existing networks**. This necessitates that **more base stations be placed at much closer distances** in order to achieve good coverage… in the case of 5G networks, the base station (BS) density is expected to be increased to about **40-50 base stations/km2** due to the high propagation loss of millimeter wave technology. …The high data rate requirement of 5G, which is around 1000 times more than 4G, is expected to be solved by the use of massive-MIMO technology, which incorporates a large number of antennas. ..Due to the extremely high density of BSs, street light access points, separate indoor BSs, relays and Massive MIMO technology employed in 5G, a person will be exposed to **very high levels of power flux densities (PFDs), whether he is indoors or outdoors, or whether or not he is using any wireless devices in close proximity**. In other words, it may be suspected that even the ambient PFD which a person is exposed to in most situations throughout the day may fall under the category of `**Severe Concern'** according to the Building Biology Standard, `**Far above normal'** according to the AMA standards, and may be **higher than the precautionary action level** recommended by the BioInitiative Guidelines."

Pall (2019) [(2)] predict that similar but much more severe effects are likely to be produced by 5G than seen currently. He also predicts that because of the roles of aqueous dissolved ions in producing these deep effects, that regions of the body with large such internal "bodies of water" may be expected to produce particularly severe problems such as:

1. birth defects because of the role of the amniotic fluids and the increased extracellular water content in the tissues of the foetus
2. blindness due to the role of the aqueous and vitreous humours of the eye
3. kidney failure due to the water in the kidney
4. cardiac changes in the electrical control of the heart, because of the large blood fluids in the heart, circulatory problems, possibly including aortic and other arterial aneurisms.

Hertzgaard and Dowie (2018) [(23)] state that " the wireless industry has obstructed a full and fair understanding of the current science, aided by government agencies that have **prioritized commercial interests over human health** and **news organizations that have failed to inform the public about what the scientific community really thinks**. In other words, **this public-health experiment has been conducted without the informed consent of its subjects**, even as the industry keeps its thumb on the scale."

5G technology that has been implemented in this country is **untested** as to the dangers it is placing mankind under. This is **irresponsible** and needs to be addressed as a matter of **great urgency** by our government and all our regulatory health bodies and the council.

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