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Anonymous written evidence

Submission to the DCMS Select Committee Inquiry 'Broadband & the road to 5G' 26.5.2020

Attaining biocompatible broadband v. the increasing toxic liabilities of old-paradigm RF escalation: an inspiring vision for Britain, integrating Covid-19 ^[12]

Written in a positive, helpful spirit, and drawing on years of study, this paper has 200+ links to supporting evidence & underpinning relevance to all the terms of reference. I am a caring scholar sharing key insights before stepping down for health reasons. I declare I have no conflicts of interest.

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Executive Summary

When analysing "broadband and the road to 5G", there is a cogent case to prioritise **biocompatible broadband**, led by creative use of **fibre**, rather than costly high-density rollouts of RF transmitters (intensive 5G/4G) and their mounting liabilities. Britain has an uplifting opportunity to be a domestic exemplar and **market leader** in biologically safe approaches (new-paradigm broadband) aided by fresh government discourse and policy, to the long-term benefit of our country.

When insurers increasingly desert an old-style industrial trajectory – in this case dense, pulsed-radiofrequency emissions– and lawyers increasingly flag the peer-reviewed scientific evidence indicating diverse risks from RF escalation plus rising involuntary exposure, this signals that RF-intensive rollouts, dense 5G cells included, are in effect becoming an *outdated, toxic asset* even before they have fully begun. Fortunately, fibre broadband/innovation does not pose these chronic

toxic liabilities and is emerging as a wiser, safer investment for Britain in these Covid-19 straitened times. When not heavily co-opted by RF cells, it also fulfils 21st century ethical standards.

While dense, old-paradigm RF rollouts dig themselves ever deeper graves, including legal quagmires, international consumer backlashes, and cumulative under-acknowledged biological risks, the contrasting potential **quantum leaps** in health-safety offered by gigabit *optical bandwidth*, a UK research strength, joins with fibre to offer a more ethical direction for our data provision – when accompanied by bio-testing and finessing to realise its biological safety gains.

Calm analysis suggests Covid-19 trends lend support to this pragmatic transition towards clean fibre broadband plus sensitive use of optical bandwidth – both with vast data capacity – **so avoiding toxic over-dependence** on pulsed RF pollution. In addition, a broadband policy environment that favours *balanced lives* over heavy e-addiction, supports consumer rights to *privacy*, and respects the needs of the *RF-functionally-disabled*, will help to ward off potential future traumas in our population, so protecting our national resilience into post-pandemic times.

On the terms of reference This paper's salient points for the **terms of reference (i-vii)** include:

▶ **i** "*what measures...will be needed*" to reach gigabit capacity – this paper calls for prioritization of measures that boost **biocompatible broadband** (i.e. non RF), namely fibre to communities, including "**last mile**" budget fibre options, while increasing use cases for bio-safety tested optical bandwidth. Several thousand peer-reviewed papers now offer evidence of RF bio-effects far below permitted thresholds, indicating risks from **old-paradigm RF pollution raisers** (dense 5G/IoT/4G/WiFi antennas). In order to favour biocompatibility for national wellbeing and resilience (re: **Covid-19**) and enjoy emerging non-RF safety markets (re: growing international/domestic consumer backlashes against RF escalation/5G) then DCMS, entrepreneurs, SMEs, et al, may benefit from the recent advice of international warning scientists, presented to U.N. bodies, that "*4G/5G antenna densification is escalating health risks*". Rather than rush into more pulsed-RF pollution (such as 5G MIMO) to meet any gaps in towards-gigabit goals, this paper calls for creative progress with fibre over a slightly longer time scale. It also advises rural network sensitivity to wildlife.

▶ **ii** "*what are the challenges to... rollout*"/*how well are they being addressed* – plans could better prioritize the above over RF 5G, especially given RF's **carcinogenic status** may soon be upgraded, increasing its business/toxic liabilities^{01. 01a.} **RF** i.e. radiofrequency (**microwave**) radiation from 30MHz - 300GHz

▶ **iii** "*successfully address[ing] the digital divide*" – policy has yet to address the digital/stakeholder needs of **a)** the RF-functionally-disabled, **b)** digital consumer sectors who, after reflection or research, wish to avoid further incremental RF irradiation of their bodies/homes and **c)** emerging biocompatibility needs of the elderly amid Covid-19 (**12c**). For "outside-in" rural provisions, see **i**.

▶ **iv** "*consumer...attitudes*" – rather than ruing international and domestic consumer pushback against old-paradigm RF escalation (and linked surveillance issues) it would surely be better to expand into non-RF safety markets, enriched by the 260 international EMF warning scientists' call to remediate rising involuntary RF exposure (and by implication "digital passive smoking").

▶ **v** "*what will be the impact on [less connected] individuals and communities*" – while fibre may boost businesses, communities and individuals who, as it were, **a)** escape the worst *RF pollution* (i.e. the unwanted by-product of symbiotic intensive RF 5G/ 4G/ IoT/ WiFi) may enjoy fewer RF-related risks and costs (e.g. oxidative/ neurotoxic/ cancer-favouring/ anti-fertility effects etc. over time, according to the accelerating peer-reviewed warning evidence) and may potentially enjoy **b)** higher rates of healthy outdoor activity, lower obesity, and mental balance for all ages due to lower 5G/4G video/gaming/data-alert⁰³over-addictions, as well as **c)** higher rates of happiness and less chronic stress from being less invaded (dense cells/IoT privacy incursions/surveillance etc. **11**).

► **vi** “*how effectively...do stakeholders..work together*” – just as with the 5G-promoter bubble gently in **2**, and the blind-spots it can create, notice the **stakeholder bubble** here (government/ Ofcom/ industry actors) with its inward loops. How badly it needs oxygenating with wider perspectives! **Do build links** and relationships with the wonderful international EMF precautionary scientists and doctors **2**: lack of direct integration of their expertise and generous willingness to help impoverishes the future, reducing your chances of co-creating British connectivity biologically and ethically fit for the 21st century, while potentially missing big new-paradigm safety markets.

► **vii** “*what is the impact of Covid-19 on the rollout of full fibre and 5G infrastructure*” – perhaps the most crucial to avoid is a **pandemic-driven panic** to augment RF escalation (further dense 5G cell rollouts etc.) rather than **a**) notice dense RF’s possible direct aggravating effects on C19 outcomes **12b**(referenced) **b**) focus resources and creativity on biocompatible broadband. You may also want to enact the suggestion by many scientists, doctors, and thousands of petitioning British citizens for a diplomatic 5G rollout moratorium to allow independent health-safety tests/inquiries.

Please read on for inspiring ways forward

1 Increasing fibre to the premises (FTTP)

FTTP has been low in the UK per capita compared with other nations⁰³. and thus current “outside in” and other plans to supply communities are uplifting and welcome. Unlike intensive wireless approaches (5G/LTE/fixed wireless/wifi/RF IoT), with the promising exception of optical bandwidth (**4** below) pure fibre broadband *both outdoors and indoors* is a superior, bio-safe future-proof technology². **providing it is not systemically co-opted by RF wireless cells** (FTTC e.g. dense 5G MIMO) and EMI is avoided, **12e**. (Bio-safe i.e. does not cumulatively penetrate living tissue with chronic pulsed RF-EMFs associated with the many risks recorded in fast-growing peer-reviewed literature, **2 – 12**). Such FTTP offers secure, low-interference gigabit / towards-gigabit capacity and, compared to invasive wireless cells, is a boon for health-savvy consumers, including all who do not, on balance, consent to further RF invasion of their homes or persons: a **fast-growing market**.

The probability RF may soon be awarded a stronger **carcinogen** status (group 1/2A) ^{04 05 06} across its spectrum, 5G/4G/Wifi bands included, underlines the **wisdom and foresight** of national community provision of non-RF broadband i.e. fibre to the premises/ indoor fibre broadband (re: schools/hospitals, **10** below) plus rapid use cases for sensitively used optical bandwidth (predicted to be less toxic than RF, **4, 12**) pending bio-compatibility finessing: both have vast data capacity.

2 Beyond old-paradigm RF escalation / 5G

Old paradigm RF-escalating trends (pulsed radiofrequency radiation pollution), including costly dense 5G from sub-GHz to millimetre-waves, are sadly **failing to keep pace** with the mounting scientific evidence and appeals of progressive EMF scientists worldwide (e.g. [here](#) / [here](#)) to move towards biocompatible connectivity appropriate for the 21st century – again, pointing to vast untapped safety markets. By contrast, “ostrich” scientists (if you might choose this image, with its gentle charm) prefer a heads-in-the-sand approach to all evidence of harm other than tissue-heating from extreme exposures:* a non-binding dated opinion that still constipates regulation.^{07, 08, 09}. Dense, costly 5G rollouts (dense RF microwaves/millimetre waves) therefore sadly augment **cumulative uninsurable RF exposure** at the very time the growing balance of EMF scientists are advising reductions, below; such rollouts also introduce many risky new features, **8**.

Therefore, to add more fibre to our national mix for RF 5G backhaul rather than for 21st-century biological safety gains misses the point: it is critical to perceive the increasingly outdated science on which intensive 5G is precariously predicated. Committing broadband choices to the old, dying paradigm (ramping up RF pollution) looks to be strikingly short-sighted and suggests precious Coviid-19-eroded resources could be better allocated.

*the obsolete 1950s “thermal” paradigm (favoured by ICNIRP) i.e. only extreme short-term exposures that heat tissue pose risks, countered by decades of progressive evidence of non-thermal RF effects, new included, while failing to address cumulative, [long-term](#), or multi-source exposures [Re: **lead/tobacco/asbestos**]

253 peer-reviewed EMF scientists from 44 nations to date (26/5/2020), authors of over 2,000 papers in the field, have warned against EMF escalation, particularly RF, urging greater use of fibre options: *"Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life."* By contrast, explains Nobel laureate Dr Devra Davis, the non-binding opinion of ICNIRP's self-elected 13 scientists, recently rejected by the Court of Turin, and among the most non-protective in the world, is attached to the old "thermal harm only" idea, and so is an outdated basis for 21st-century guidelines. See cautioning scientists' "[EMF Call](#)" and this [substantive paper](#). Thank you.

With regard to 'what measures/challenges' (►1st/2nd terms of reference), the accelerating science recording toxic risks from RF is **an invaluable gift** for policy-makers, entrepreneurs, product designers, and broadband asset re-balancers, for it reveals transitioning to more fibre, plus delicate use of safety-tested optical wavelengths (predicted to be free of most of the prolific published toxic risks linked to pulsed RF) is the gold standard way ahead. The 5G 'bubble' appears to be collapsing into RF-over-dependency, at risk of early redundancy, by failing to develop this inspiring transition.

The EU reports "**Late Lessons, Early Warnings**"¹⁰ present many dire, costly failures to mitigate toxic trends. UK research fellow David Gee has an uplifting message: experience shows precaution can *stimulate* profitable innovation; by contrast, incautious rollouts or technology "lock in" can be chronically and disastrously costly. It is fortunate that Britain does not manufacture 5G equipment! And so is well placed to adapt and outdistance nations to a more fibre plus safety-researched optical future (4), a trajectory which is **already our research strength (4, 10)** and points towards realising and capturing *new paradigm* safety markets.

How fitting that our beautiful **Britain** – land of gardens, parks, green urban niches, and varied wild landscapes – could with the right policy stimuli and ethical enterprise be **the prosperous cradle of this transition beyond RF over-dependency**. One in which a *higher proportion of our data* is delivered bio-compatibly, so averting the worst of the emerging RF cumulative risks to health*/ecology (see 9f for pollinators). Britain was once the smog-filled "dirty man of Europe": if we remain over-committed to becoming RF/5G intensive, then we will surely be so again, with spiralling toxic liabilities, legal included, and – according to all the substantive accelerating peer-reviewed warning science – ultimately a sick nation. Let us instead be the proud garden nation that is, and long has been, our vibrant and inspiring exportable strength. Britain: a domestic exemplar and market leader in biocompatible non-RF broadband, mirroring the physical beauty of our country – an inspiring, positive, vision to take us beyond Covid-19 stressed times.

* notably children with their high RF absorption
and developing nervous systems^{11 12 13 14}

3 New markets for biocompatible non-RF connectivity

Markets for non-RF, genuinely bio-safe technologies (potentially vast) look ever-closer to breakthrough. The International Business Times, for example, has just flagged the toxic potential of 5G,¹⁵ while educated international / domestic grassroots consumer awareness of peer-reviewed electromagnetic health risks has been rising visibly year on year. Among the many grassroots consumers already repulsed by 5G trends, the more perceptive cite with strong justification **a)** the accelerating peer-reviewed warning science on RF ^{16, 17, 18, etc} **b)** universal human rights affected by

[rising involuntary exposure](#) **8** (plus frameworks supporting them^{e.g.} [19](#) including rights of the child²⁰) and **c**) the non-consensual [experimentation](#) 5G trends imply. ²¹ (This contrasts to voluntary exposure from any self-owned devices, which - however polluting - can at least be switched off freely). This view is supported by increasing numbers of doctors in the field, as illustrated below. 1,300 [Belgian](#) doctors and care-workers have meanwhile objected to the imposition of 5G. ²² Thoughtful global backlash is set to grow – perhaps exponentially. Inspiring, bio-friendly non-RF broadband beckons.

377 scientists and doctors to date (26/5/2020) have signed a rolling EU [medical appeal](#) for a **"halt [to] 5G RF-EMF expansion until independent scientists can assure that 5G and the total radiation levels caused by RF-EMF [5G on top of 4G, WiFi etc] will not be harmful for EU-citizens, especially infants, children and pregnant women, as well as the environment"**. They explain many kinds of harm from RF have been identified to date and 5G raises net *involuntary exposure*, potentially creating inhumane conditions in which no one can find refuge. Citing the Nuremberg Code, they state the Precautionary Principle should be applied as an emergency by halting 5G expansion to permit bio-safety research by independent scientists.

4 Fibre's possible ethical partner: optical broadband

British independent bio-safety tests of light-based wireless communication (LiFi/VLC/OWC) would therefore be acutely timely and wise. Though such tests are needed ASAP, it is often predicted to offer the biocompatibility increasingly shown to be gravely lacking in penetrating RF (WiFi/4G/5G/fixed wireless/RF IoT etc.) **2–12**. It offers a versatile complement to fibre, including outdoors (see e.g. Free Space Optical/embryonic French street LiFi) and, like fibre – so safe, inspiring, and futureproof – its brings the uplifting chance to clean up many environments by **progressively replacing** RF, not least indoors. Some of its data-coding techniques are more delicate than those used for RF (pulsations of the RF carrier wave tend to ramp up published harmful effects below*/**9**). It therefore offers a potential *ethical way forward* for policy-makers/ businesses **providing** optical safety tests are made alongside sensitive bio-safety assays to screen for, e.g., any neural disturbance (via optical nerve bundles) or changes in micro-fauna etc, see [appendix](#). For example, testing for the most *bio-compatible modulation* (the use of colour looks promising) will help to avoid the endless, grave past technology mistakes in focussing on technical aspects rather than biological interactions.

If, during use, our eyes perceive LiFi/VLC as morphologically identical to natural light, as is hoped, then the possible biocompatibility would be a Eureka point for humanity. This then suggests a higher step change that deserves a *positive new name* rather than yet another polluting "G" – an ethical partner for pure fibre's own vast biocompatible data capacity. There is also scope to innovate to make the **colour spectrum** of LEDs themselves less unhealthy (so protecting circadian rhythms) while removing **flicker** (see [appendix](#)) – another big market opportunity. Obviously, the biocompatibility gains are from **bidirectional** LiFi/VLC/OWC, not WiFi hybrids which sadly perpetuate the peer-reviewed RF toxicity (see **9e** for fast-growing [WiFi](#) evidence) and "old think".

In global health-fashion terms, it is easy to imagine that delicate non-toxic energy efficient wireless-light environments (when genuinely tested and finessed for bio-safety, above) will be the new "cool" while pulsed RF radiation will be seen as antiquated pollution.

Our beautiful Britain would therefore do well to bypass RF densification wherever possible (and chronic **THz-gap** radiation, currently a similar old-paradigm toxic approach, see [appendix](#)) and become a **world leader** in innovative fibre plus some safety-finessed light-based connectivity. The latter is already under research in 5+ of our universities – an uplifting prospect for our country if these are set to work rapidly on bio-safety assays by independent scientists.

***extensive peer-reviewed** research reveals the [pulse/polarization/variability](#) of wireless output tends to ramp up its toxic potential. (Do work for fibre rather than e.g. WiMax with its notorious **harsh pulse amplitude**) Disease-friendly, tissue-ageing [oxidative stress](#) has been found in numerous studies on RF-EMFs^{23 24} and

is a key way such artificial non-ionizing radiation can lead to hidden ongoing cellular/systemic damage.

Evoking **King Canute**, the 1950s idea that tissue heating from extreme exposures is RF's only hazard (this sadly infects policy via ICNIRP) faces a growing tsunami of science indicating the need for more use of biocompatible connectivity. The **latest peer-reviewed findings** on pulsed RF at everyday levels are sobering, as ever, and include: more evidence of *antibiotic resistance* in bacteria exposed to WiFi/phones²⁵; 5G spectrum risks to the Western Honeybee³³; emerging cell-phone risks to healthy heart rate variability,²⁶ epilepsy,²⁷+people at genetic risk of thyroid cancer;²⁸ WiFi harm to animals' hippocampus and memory;²⁹ RF damage to seedling roots;^{30 31}oxidative and other harm to small animals' blood/liver from UWB pulses³², and so on – far more than can be listed here. Although, among the vast range of end-points tested, some null results arise, such ever-growing findings cry out for more use of bio-friendly options. Such advances could be easily, prosperously addressed by **British creative enterprise** – from fibre 'smart' buildings to low-EMF routers³⁴, from delicate optical meshes to safety-finessed [school](#) LiFi: the possibilities are endless.

5 Rising 4G – emerging risks to biodiversity

The Inquiry invited feedback on rural 4G network plans. Dr Alfonsi Balmori, a leading peer-reviewed scientist on RF wildlife effects, advised me increases in rural 4G may have biodiversity costs over time, with bird and insect populations remaining most buoyant in the cleanest areas. Notice deeply concerning research on mast output and [insect imbalances](#), [nesting sparrows](#), [amphibians](#) etc. Some digital thinkers may value wildlife **7**: do encourage *forward-looking technical creativity* on how to attain minimal 4G functionality with ALARP (i.e. minimal) pollution. Peer-reviewed research also suggests some [tree dieback](#) may increase with mast numbers and/or shared masts (=multi-cells) and 4G power levels. Emerging fieldwork on **birds**, [as here](#), is meanwhile deeply troubling.

DCMS's shared **rural network plans** for 4G densification across areas that currently have low or no 4G pollution therefore need to factor in sensitivity to each area's **wildlife**. Research gaps in this field underline the Precautionary Principle. Please check carefully you are using basic 4G, **not 5G hybrid/ hybrid-ready 4G LTE Advanced/similar modes**, with their emerging added risks: see **8**.

Do work to refine Ofcom's **proposed law** on coverage so it is genuinely sensitive to local wildlife – and also to EHS below – rather than a clumsy strait-jacket that could provoke growing distress and/or complex litigation. Do also devise ways to minimise and monitor Shared Rural Network longitudinal impacts on biota, while scoping technical expertise on how to:

a] protect **SSSIs & National Parks** from rising 4G (or 4G/5G hybrids **8**) and from a humanitarian point of view,

b] **respect communities** who want to conserve their no-pollution status (e.g. Capel-y-ffin) and also communities who *may want the option of reduced pollution in the future* by, for example, audited reconfiguration of a 4G dipole. This protects democracy and addresses some of the emerging growing needs of the **RF-functionally disabled** ([EHS, 9a](#)) for equality, respite, and refuge from RF saturation: thank you on their behalf.

The 253-scientist International Appeal above (**2**) advises creation of no-pollution 'White Zones'. UK policy currently lacks conservation of any near-equivalent zones/niches (e.g. outdoor low signal strength): do rectify this **major oversight** to conserve their irreplaceable resource. You might, for example, want to *strike a topographical balance* by, e.g. focussing 4G on rural industrial estates rather than habitats/homes while offering minimal 4G for **basic messaging on the move** and retaining clean (near white-zone) prime habitat niches/refuges. Do also anticipate eventual growth in the Digital Detox business sector as big-data stressed workers and families, and 'wilderness' consumers increasingly seek out clean, offline nature settings.

Why not hold a new **innovation prize** for non-RF, bio-friendly rural/last mile solutions? Though more fibre cabinets will offer good over-copper speeds (VSDL/G-fast etc.) to many users, do also check for any innovative advances in e.g. RONJA data speeds, another bio-sensitive approach.

6 Phonegate-plus: uninsurable old-paradigm 5G

Inviting comparisons with Dieselgate and similar collapses, [Phonegate](#), Fibergate, and other new litigations around the world on health-safety (or questionable practices, sadly) add to the evidence that committing heavily to RF escalation looks very short-sighted. Tobacco “safety”, for example, had protracted death throes (“More doctors smoke Camel”) but the world we now inhabit does not tolerate such last-century protraction. Today’s reversals can happen rapidly when toxicology is involved. Cumulative 5G (MIMO/IoT/adjunct 4G) already faces what many may perceive as an inevitable **growing storm** comprising **a**) increasingly substantive warning science on RF exposure (*several thousand peer-reviewed papers now contain evidence of RF toxic risks/effects far below “thermal” levels*)³⁵ **b**) growing global consumer backlash, and **c**) 5G’s **un-insurability**^{e.g. 36} (big insurers are deserting EMF/RF transmitting products/infrastructure based on their own research of the science signalling harm) as well as probable legal morasses over time, incurring unsustainable costs. *Notice for example* that the many diverse cancerous lesions from RF radiation found by the vast [NTP study](#) have been largely replicated^{37 38} by Europe’s respected Ramazzini Institute at exposure levels similar to masts/street cells etc.^{39 40} (I had the privilege of hearing the lead researchers present their work at a large medical conference). There are numerous other elegant examples among the several thousand papers containing evidence of RF risks. Dear All, it is surely time to leverage non-RF, non-toxic broadband.

7 Creative reductions in RF-EMFs

In fairness, many individuals in digital services/DCMS may not be aware of the full precautionary picture, and the inspiring extent of peer-reviewed warning science on pulsed RF radiation – from systemic [oxidative](#) risks (re: heart disease etc.) to neural/ infertility/ genotoxic findings and mechanisms of harm^{41 42 43} **9, 12**. If there has been an aversion culture i.e. a slowness to explore and work for greater bio-safety, let’s hope this is poised to change. Biological RFI is a useful unifying concept: [appendix](#). Some helpful **modernizing role-models** are emerging, ranging from, for example, former head of Microsoft Canada, Frank Clegg, to Silicon Valley speakers,⁴⁴ to new start-ups by IT experts inspired by the precautionary science. Policy-makers do not have to wait for widespread harm to wellbeing or legal crashes to appreciate or adopt such forward-looking thinking – in truth, it could be blinkered not to – and some countries/states are already ahead of us e.g. ^{45 46 47} In our virus-shaken times, such respect for biology holds **energizing wisdom**.

Some thinkers in UK digital businesses may reflect privately “I enjoyed a safe childhood: I want my kids/ grand-kids to enjoy the same. I haven’t been up to speed on the fascinating research on wireless toxicity. It makes sense the penetrating pulse/polarization etc. can drive unwanted effects. Hmm. Let’s see if we can use our talents and tweak functionality to take fibre/two-way LiFi, or slash the RF/down-tune the pulse, or default to flight mode – and then perhaps market ‘*enjoy the peace of our tweaked product-line*’ or ‘*wake up to beautiful light-based broadband*’ or ‘*announcing our non-RF eco-mode*.” (LiFi is more energy efficient). And so on.

Without broadband policy favourable to such creativity, however, ethical British resourcefulness may struggle. (See **13/appendix** for possible stimuli). Much research correlates [conscientiousness/care-giving](#) with longevity:⁴⁸ perhaps caring ethics will be found to have similar benefits. To aid DCMS discussion, meanwhile, here is an interesting case history; see **8c** for supporting material.

Adjusting broadband: an interesting case history [Silicon Valley's](#) Peter Sullivan is a brilliant technophile engineer who began his career as a pilot before becoming a leading software designer in large ICT companies. Despite good fitness regimes, however, both he and his family experienced inexplicable deteriorating health with his sons spiralling into autism. Still working in hi-tech but using his trouble-shooting brilliance to tackle this tragic trend, Sullivan addressed his family's diet and heavy metal exposure. Seeing only limited improvement in his sons and none at all in his own health, he eventually researched EMF bio-effects and experimentally slashed the pulsed RF load in his home, notably its wireless broadband. His family still enjoyed good data access but it was delivered with electromagnetic hygiene. It seemed transformative. His sons' autism melted away and Sullivan recovered vibrant health. Having helped many other families to reduce autism using a similar approach, he now supports progressive thinking on delivering digital access hygienically – an inspiring direction with many potential economic gains and untapped markets. In interview (above), Sullivan admitted *'I realized that I don't want to be that person who doesn't look at their own stuff, their own industry. And so I started looking at the wireless stuff. You have to, you can't have biases, you have to systematically look at everything. And then when [you do], you go 'Wow, we are really, really, biased on this topic'.*

8 Russian roulette? 5G non-testing / biological risks

More signs RF 5G is becoming a toxic asset (re 1st/2nd terms of reference) – inviting government-stimulated non-RF measures rather than further rollouts that would be justly stranded – are identified testing paucities. Concluding that providers are “flying blind”, a distinguished [lawyer](#) exposed zero independent health-safety testing in a formal hearing, a point further expounded by at least two British charities.^{49, 50} Eminent scientists have made similar points: award-winning biochemist Professor Martin Pall observed *“putting in tens of millions of transmitters without a single biological test of safety has to be about the stupidest idea in the history of the world”*. Certainly, UK test-beds have been starkly asymmetrical, looking only at technical parameters, not biological effects. Many might also point out reasonably that no tangible consent was obtained from residents subjected to their RF-EMFs – **a striking contrast to drug trials** – nor to the preliminary rollouts that have since occurred in UK cities.

5G rollout, especially if further or preferentially pursued, adds multi-RF *on top of* other extant sources. Its **mid/lower-range** frequencies (already in many UK cities as a 4G/5G **hybrid**) labour under weighty evidence on RF toxicity, see [Pall 2020](#) pp1-26, while its pending **higher** frequencies incur further evidence pp 27-30 and below. Sadly, the concentrating techniques of 4G/5G hybrids (4G-LTE+, **5**) such as QAM pulsations and carrier aggregation, may plausibly already be making UK RF pollution *more bioactive* – see pulse effects etc. above **4** – while dynamic spectrum switching, etc., if permitted, may further [outstrip](#) life's poor ability to adapt.

It is critical for all **policy-makers to be aware** 5G rollout also introduces further **novel/ added risks** including: **a]** high density transmitters closer to heads, pushchairs etc. than pre-5G modes **b]** very dense RF IoT 'connections' (if further permitted) adding to rising net exposure **c]** beam-forming (& shifting crossfire hotspots) reducing amelioration of distance **d]** higher downlink exposures⁵¹ **e]** further complex pulse modulations (potentially risking “permanent tissue damage” from user devices' intensity spikes, peer-reviewed⁵²) **f]** plausible risks to [medical implants](#) **g]** pulsed higher frequencies, from 6GHz+ to millimetre waves, posing logical new risks to **skin**, [eyes](#),⁵³ **insects**, [trees' leaves](#), **micro-fauna** etc.^{54 55} as well probably relayed toxicity in deeper tissue^{56 [17]} and reduced DNA repair: ⁵⁷ Professor Belyaev concludes toxic risks from 5G's higher frequencies may exceed all other RF spectrum in common use – even before factoring in the pulse etc.

In contrast to *non-co-opted fibre broadband 1*, whatever alleged benefits of 5G escalation might be floated, none will remove the fundamental ethical failures many perceive, or its complex, unsustainable liabilities.

Drawing on biologically based exposure metrics, a [new IEEE paper^{\[+here\]}](#) advises if full 5G rollout is permitted, then '*Due to the extremely **high density** of Base Stations (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 PFDs (RF power flux densities) whether he is indoors or outdoors, or whether or not he is using any wireless devices*' it concludes "*almost all people in the area of coverage may be exposed to dangerous levels*"; new [physics modelling](#) confirms the general rises.

9 Business-relevant RF burdens on productivity, wellbeing, ecology

While policy-makers, businesses, and communities will be aware of severe wireless broadband/IoT security issues (**d** below), it is critical to be equally aware of the risks and harm *the growing balance* of scientists in RF bio-effects (e.g. **2**) are bringing forward. To help the Inquiry/DCMS to **understand the burdens** these crucially imply, here is a brief scholarly introduction, drawing on the substantive peer-reviewed published evidence:

a] Loss of productivity and societal/business costs from 5G/wireless-accelerated functional **disabilities** related to wireless RF-EMF exposure, already becoming prevalent according to new peer-reviewed research^{58 59} including in a [growing proportion of our workforce](#) (2019 peer-reviewed): overlooked stakeholders. I had the privilege of hearing Professor D Belpomme present the many biomarkers of RF injury his team have identified in **2,000** such patients; he anticipates this is the tip of the iceberg. While past 'provocation' studies failed to allow for the slow-building, lingering pain/loss of function to which so many testify, pilot functional MRI scans lend striking support to the disability.⁶⁰ On **broadband**: a [new](#) paper advises "safer wired networks should be used instead of wireless" for equality (►3rd term of reference, *digital divide*). A recent English court case has recognised the disability (also called [EHS](#)) and awarded income support.

b] While various factors can affect our **immune systems**, including chemical stressors, there is a raft of peer-reviewed evidence indicating chronic pulsed RF can have a net immuno-suppressive effect ^{61 62 63 64} whether from proximate devices, or masts.⁶⁵ It is possible rising exposure (e.g. elderly patients) may perhaps be playing a subtle role in some non-optimal Covid 19 outcomes **12b**.

c] Mental health/neurodegenerative costs from rising RF exposure e.g. autism (notice this Harvard neurology professor's seminal double paper^{66 67}) and potentially ADHD.^{68 69} Numerous RF neurological effects have been documented in peer-reviewed literature.⁷⁰ Professor Colin [Pritchard](#), UK, perceives EMFs may be perhaps contributing to many rising neural disorders. [VGCC](#) effects, a key **mechanism** of wireless-radiation harm,⁷² may apply particularly to nerve cells.⁷¹

d] Potential risks of *infertility*^{73 74} and diverse *cancers*^{75 76} **6**. RF's carcinogen status, time-tabled for review, may well be [upgraded](#): a good advance **incentive** for businesses/DCMS to favour non-RF broadband and more use of fibre-to-screen workstations – with the added benefit of fibre's sturdier **data security**. It is wise to recall that former CIA chief James Woolsey identified wireless smart-grids, for example, as wildly insecure while wireless IoT of whatever origin is already an identified security nightmare: see Nokia [report](#).

e] Burdens from growing 4G^{66 77 78 79 80} and **wifi** (fast-building peer-reviewed [evidence](#) of wifi exposure risks includes dental [mercury](#) release into our saliva⁸¹, antibiotic resistance ^{82 [25]}, wifi frequency DNA harm,⁸³ reduced sperm counts⁸⁴ and sadly, diverse harm to tested animals' tissue.⁸⁵)

f]. With **insect biomass** in dizzy decline,⁸⁶ it makes economic sense to avoid placing further burdens on it, **8** There are new peer-reviewed published risks to our honeybees [from the higher frequencies](#) being lined up for 5G 'smart' towns/cities/villages: bee populations which critically help to compensate for agri-pesticide losses etc. (notice this [detailed overview on bees](#)). **Trees** will also highly absorb such frequencies (Ordnance Survey data); their leaves may suffer oxidative harm (via

VGCCs⁸⁷). [Lancet](#) Planetary Health has flagged ecological/health risks of rising RF while Professor Bill Sutherland et al's 2018 horizon scan identified 5G EMFs as a possible threat to natural capital.

[History](#) has shown repeatedly that economic claims, including from sources with conflicts of interest, **can blind us** to accelerating evidence of risks and harm (re: *passive smoking, asbestos, dieldrin*). A key challenge to UK broadband provision (►1st term of reference) is therefore **cognitive dissonance** that is holding up favouring wise, bio-sustainable RF-mitigating choices.

10 Markets for future-proof non-RF buildings

A new thought-leading paper (June 2020⁸⁸) points the way towards potentially limitless markets for healthier broadband in buildings, including fibre 'smart' functions/automation (with EMI remediated) replacing **RF-sick building syndrome** with biologically wise **electromagnetic hygiene** – so offering a future performance indicator and gold standard*. Germany's longstanding Bau Biologie institute, for example, is a leader in sustainable building protocols including such hygiene.

Why not urge the UK take the lead? Because old paradigm wireless-tech, 5G included, has so many intractable uninsurable safety issues (also predicted for specious THz "6G", see [appendix](#)), then untapped markets await for better products. Evidence for the need for **new-paradigm, non-RF broadband in schools** is becoming increasingly apparent (7)⁸⁹ [\[14\]](#) [90](#) and as with most other buildings (offices, care homes, big-ticket residences, wellbeing clinics etc. etc.) *offers inspiring opportunities for enterprising/ethical policy-makers and businesses* to **befriend** the accelerating warning science, innovate/adapt to remove RF-EMFs (and EMI) and **capture the market**: a beckoning future. ►The *Rural Gigabit project* could make an easy, praiseworthy start by exploring biocompatible broadband for its sentinel primary schools, e.g. LiFi, [4](#).

Simultaneously, expect house price instability near 5G/4G cells. 5G transmitters near children's bedrooms, for example, raise many emerging ethical issues. A humane moratorium on intrusive rollouts would be a wise policy, [13](#), giving preference to FTTP without systemic parasitic RF cells, [1](#).

11 Online/offline: broadband and the benefits of balance

While consumer and business take-up of connectivity may reveal some attitudes (►4th term of reference), it may miss key misgivings about gigabit trends, offered here to round out the Inquiry.

Few family users (Christian/other-faith business leaders included) will privately want a Britain in which youngest generations, their own children included, are at risk of the published negative brain changes from big data/gaming **addictions**,⁹¹ [92](#) [93](#) [94](#) an added mental health burden⁹⁵ on hard-pressed Covid-19-stressed communities. When looking at **community take-up**, do factor in the psychological health, happiness, and resilience afforded by *quality time offline* including in *living nature* [12g](#) (see research on "vitamin [N/G](#)"). Broadband has its utility and Covid-19 accented remote working but rounded lives are in danger of being *gigabit-eroded*. If a life online is a life unlived (e.g. 5G video addiction) we may face community nose-dives in [obesity](#) /active sport/ [self esteem](#) / [depression](#)^{+[\[13\]](#)}/ [etc.](#) and potentially [empathy](#) (all peer-reviewed) and thus much-needed resilience, particularly across vulnerable groups, with or without any future reprised lockdowns.

Gauging attitudes from take-up may also miss mass misgivings on **privacy** and **surveillance** [96](#) [97](#) [98](#) (data privacy, invasive eye-tracking, IoT 3rd party profiling, 5G geolocation within a metre, etc.⁹⁹) worsened by dense 5G/IoT antennas, if further permitted. Tackling and shrinking these serious intrusions may be crucial to national wellbeing.

12 Beyond the storm: Covid-19

While the pandemic (►7th term of ref.) has been poignant for our country, it is an invitation to take deep pause, notice grave blind-spots in collective thinking, and work to address them. In this spirit:

a] Given Covid-19's cost to the public purse, it is surely prudent to plan phased reductions in or withdrawal from **toxic assets** – including, drawing on all the evidence given here, reconsidering the RF-intensive trajectory of much of UK broadband/5G provisional policy to date. Commerce is

already looking at the gains of LiFi/optical gigabit capacity¹⁰⁰ (also LiFi phones/tablets, see UK research [here](#)) while the transatlantic white paper [Re-inventing Wires](#), by a distinguished communications expert, offers you fresh common-sense pointers on fibre networks, helping to counterbalance any wireless-RF-5G over-sell, if or where present, in these C19 times.

b] It would be helpful if the Inquiry Committee appreciates (and brings to its decision-making, ► 2nd/5th/ 7th terms of reference) that a growing number of precautionary scientists are helpfully highlighting evidence that rising chronic RF exposure may disadvantage our immune systems (see e.g. **9b**, **9d** and **4** oxidative stress) and so, as with other immune stressors, **RF escalation could be unwise** in the context of managing pandemics and may contribute to suboptimal elderly/herd immunity over time. STOA, the EU Parliament science & technology panel, were due to include this pressing issue in their C19-cancelled hearing on 28 April. In conscience, dear All, I should mention that substantive peer-reviewed cautioning papers also indicate possibilities that rising chronic RF exposure (wifi broadband/tablets/4G/5G etc.) may exacerbate C19 outcomes, or bacterial secondary infections, in additional ways, including:

- possible exacerbation of *co-morbidities* that can worsen C19 patients' outcomes (see **9** and, e.g., peer-reviewed RF cardio-toxic ¹⁰¹ and pre-diabetic findings ¹⁰²).

- published changes in in *viral/bacterial* replication (e.g. oxidative stress/viral virulence¹⁰³; RF-cellular calcium changes^{104 105} – see [VGCCs 9c](#)): notice also peer-reviewed wifi/mobile-phone/millimetre-wave ^{1251 1821 106 107 108} risks of *antibiotic resistance*: not ideal for our NHS.

- possible dips in *blood oxygenation* (not ideal if unwell with C19). Professor Emeritus M R Cooper DPhil (Oxford), having noted such peer-reviewed RF risks, e.g.^{109 110} is advising against added RF exposure. Some doctors have noted oxygen-lowering [Rouleaux](#) effects in sensitive individuals.¹¹¹

Fortunately, the fast rising RF density in our hospitals, for example, from wireless broadband etc. can be remedied with wired/optical connectivity, benefiting adaptive British digital businesses, **10**.

Given PM Boris Johnson recently quoted Cicero's ***salus populi suprema lex esto*** (*let the people's safety be the supreme law*), I imagine he would be very supportive of your Inquiry committee if you were to bring all such broadband policy considerations calmly into his view.

c] (► 3rd term of ref, "**digital divide**") For Covid-vulnerable elderly consumers etc., access to non-RF broadband such as fibre-adapted screens, especially for prolonged use, is therefore emerging as a sensible option; ditto reduced wifi/DECT etc. in *care homes*

d] (► 1st term of ref, "how realistic") In these fund-stretched C19 times, let's not forget that the latest over-copper protocols (VSDL etc.) are delivering higher data rates to many homes and businesses around Britain than was once anticipated. **Community-friendly tariffs** for this might be a simple mechanism to help various less connected communities/businesses in our Covid-19 stressed nation, rural included. Notice, too, self-help rural fibre-laying (e.g. BR4N) reveals extraordinary value for money. Such models indicate there is no need for any **Covid-19 panic induced rises** in pulsed-RF broadband across towns, villages, and landscapes.

e] I notice many consultants see little business case to justify the expense of dense 5G cell networks/rollouts, other than, e.g., localised use in factory automation: here is an [astute example](#). (You might add perhaps: downloading a HD film onto a mobile screen in seconds rather than a minute seems frivolous or unnecessary beside all the emerging risks and harm). Integrating the wisdom of all the frontline EMF warning scientists, you might therefore decide on fibre-led connectivity to communities, rural included, over a **slightly longer time-frame** rather than pushing into further wireless-RF rollout (5G MIMO/fixed wireless/dense LTE etc) with all its hidden costs and legal/insurance quagmires. Where fibre-optics are used, **care to avoid EMI**, see [appendix](#), will realise its healthy potential.

f] In terms of revenue, you might also perhaps consider a **windfall tax** (see [Financial Times](#)): communications have had a windfall from the C-19 crisis which exceptionally forced many people into teleworking etc. This might then be used to help modernize broadband provision away from dense RF pollution (FTTC crucially included) gently in line with the "polluter pays" principle.

g] To round out the Inquiry in the context of Covid-19, do include **businesses that celebrate time offline** in your total broadband/communities picture. Gardening, for example, is big business, while physical time in nature itself (such as mindfulness in nature/fishing/gardening¹¹²), especially outdoor exercise in green environments,^{113 114} has well documented physical and psychological wellbeing gains that can contribute to *Covid-19 national resilience*. (A recent major [meta-review](#), for example, equates it with physical vitality and happiness.¹¹⁵) There is perhaps a more fundamental connectivity than data, one which has given intergenerational consolation through the ages – direct embodied delight in living nature, including outdoor sports – which will help to tide Britain through times to come. The respected research-backed [Green Mind Theory](#) of wellbeing suggests, for example, that crafts/reflection/physical activity in living nature are vital to balance urban/contemporary (and perhaps gigabit) over-stimulation and its emerging neuro-plastic health costs.

To summarize on Covid-19 and broadband policy: **let us not replace** one toxic burden, the viral pandemic, with another: a virus-panicked epidemic of ubiquitous pulsed-RF pollution (dense 5G/4G/wifi/loT/fixed wireless) with all its emerging cumulative peer-reviewed risks and liabilities **2-12** (and also possible costs to life balance **11**). Please use C19 depleted resources more

13 New-Paradigm Tectonics

Overall, then, an overriding challenge to UK broadband policy is how to progress in a more biocompatible future-proof way than old-paradigm thinking, with all its limitations, has afforded. New-paradigm **plate tectonics** are moving under our feet: when so many EMF scientists on the frontlines of research are finding starkly troubling effects; when the more thoughtful, well-supported 5G consumer backlash around the world is deservedly growing; when Covid-19 underlines our need to proceed with biological caution and fresh thinking, then there is everything to be said for boosting the bio-safe options (► 2nd term of reference, on spending etc.)

Another positive step you might enact is to halt 5G rollouts (accessory 4G antenna densification included) diplomatically and efficiently to permit a large, fully independent safety inquiry. [Slovenia](#) and New Hampshire, for example – see [law](#) passed here – have already begun. An inquiry with cross-party involvement and special powers to put aside the dead weight or circular thinking of all bodies/stakeholders who have been accessory to rollouts to date. A new broom, crucially including top international precautionary expertise (see **2**). Otherwise there is a danger circular 5G “group think” is starving UK broadband rollouts of fresh critical thinking on their bio-sustainability, lack of bio-safety tests included (**8**) with negative consequences for our country (and NHS), including from RF-exacerbated health conditions.

We, the British people, as our Blitz-spirit response to lockdown warmly demonstrated, would clearly respond positively to the prudence & ethics of such course – including government needs to avoid costly toxic assets. (The pandemic has also been wonderful public training in **mutual care for each other** if reducing *RF “digital passive smoking”* should one day become inspiring policy). Simultaneously, the warm, upbeat business-friendly message is that new-paradigm bio-safety advances (genuine, not a fig-leaf on RFrisks) offer an exciting field for technical adaptation/creativity plus lively markets as global grassroots precautionary-science awareness continues to build sturdily.

Therefore, rather than building RF castles on the quicksand of the old dying science paradigm (**2, 4**), our nation has a **historic chance** to start delivering an **increasing bulk of our data** in ways that are genuinely, ethically biocompatible – as set out in a constructive spirit throughout this paper – ways that could stand up with probity to all independent testing: future-proof broadband.

CONCLUSION

In summary, there is growing evidence failures to prioritize non-RF broadband, fibre included, over increasingly dense RF antennas (5G/RF IoT/LTE etc.) are ultimately short-sighted, biologically risky,

and an increasing toxic liability. Rather than smooth the road red-flagged by ever-growing numbers of peer-reviewed EMF scientists, doctors, and lawyers to potential RF-exacerbated disease risks, disability, human rights breaches, risks to pollinators, other emerging harm, and multiple uninsurable costs and litigation, policy makers and conscientious stakeholders have an uplifting, unparalleled, **historic opportunity** to advance/regulate towards gigabit capacity that has *gains in electro-magnetic hygiene*, including versatile *biocompatible fibre broadband*, outdoors and in, as well as, with bio-safety finessing, sensitively applied optical bandwidth. In other words, broadband with ethical bio-safety advances fit for the 21st century plus vibrant untapped safety markets.

Systemic blindness to these issues will plunge our country into dense RF pollution – so becoming an electromagnetic “dirty man of Europe”, mired in obsolete science that, unlike the insurance industry, under-estimates cumulative RF toxicity. This will incur unsustainable business/government liabilities alongside creeping humanitarian, ecological and medical costs when Covid-19 has already shrunk our future capacity to absorb or ever recover from such long-term traumas.

The ultimate take-home message is however inspiring: **what better place than Britain**, land of beautiful diverse landscapes and countless vibrant micro-gardens, to be the prosperous cradle of this paradigm shift towards **genuine biocompatibility** – and also balanced, low-addiction living with all its inter-generational joys and health resilience.

As a country we have the know-how in affordable fibre and cutting-edge optical research to realise market-winning safe ways forward while averting the RF pollution car-crash we are currently revving up so blindly. Now policy-makers and digital sectors, entrepreneurs and SMEs, need to nurture this adaptive non-RF gigabit future with foresight, ethics, and biological wisdom – for the ultimate wellbeing of our country.

Appendix

► **i Policy/market mechanisms for hygienic broadband** Taking the **long view**, these could allow companies to make staged reductions in their *RF pollution footprint*, so creating a virtuous circle.

Quick illustrations:

a) Feel-good ratings for buildings You might imagine eventual ratings examples, e.g. *5 star* “Fast fibre to LED broadband, with no EMI, and complementary screens and adapters for customers whose older-style devices do not yet support this function” *Brochure*: “Relax! no more headaches or fatigue or ageing free radical damage from old-style broadband: our rooms are beautifully designed with 5-star winning *electromagnetic hygiene*. Relax in deep refreshing sleep, as if bathed in nature, safe in the knowledge that no pulsed microwaves/mmwaves (RF) will be emanating from within our building or from cells within [distance in km] of its grounds.”

b) Environmental audit mechanisms can incentivise providing a service, in this case connectivity, while *reducing unwanted by-products*, in this case RF pollution (ditto chronic THz-gap pollution, below) while offering a government revenue stream. For example, taking the long view, A to G *RF-emitting ratings on consumer products* could be taxed in the higher bands. The ratings might combine: reduced output (consulting EMF precautionary engineers [2](#)), reduced pulse amplitude [121](#), antennas off between use (e.g. tablets/routers*) and lower duty cycles (e.g. smart meters). This wouldn't prevent higher *net* exposure from more dense/proximate sources (and without a supporting measure may even exacerbate them) but models the right direction.

*e.g. at present, many consumer devices chronically irradiate sperm/ pregnancy/children/over 70s with no design remediation for published peer-reviewed RF neurological risks,etc. There is huge **scope for improvement; however**, non-RF functionality (without resorting to trans-humanism [v](#) below) will be the real quantum leap.

c) Air pollution Some scientists have called for electromagnetic and chemical air pollution to have parity or be addressed jointly; [122](#) [123](#) research points towards *toxic synergies* between the two. [124](#) [125](#) Just as not-for-profits now advise *estate agents* [126](#) to declare chemical air pollution levels, ambient involuntary RF-EMF levels could be declared (especially in cell/mast main fall-zones). However, pulse, signal, and non-linear window effects would need a more sensitive instrument.

d) RF Footprint Credits Just as with carbon credits (active in some nations and not others) this is an effective market mechanism to reduce toxic by-products while supporting businesses forward.

► **ii Best practice: fibre broadband** While fibre (and/or optical bandwidth) can remove/reduce the RF load in many environments, not least indoors, **good design and practices** will prevent any **piggyback EMI*** (HF transients) such as from street-to-home fibre optic electrical converter boxes lacking capacitors¹¹⁶ – adding to any in-home sources (e.g. unredeemed solar power inverters). Though follow-up research is needed, preliminary studies suggest HF voltage transients may bring possible diverse chronic health risks.^{117 118 119 120 121} Because human physiology is exquisitely bio-electromagnetic, [gated ion channels](#) included (re Professor Pall's [elegant mechanism of harm](#)), some biological EMI – especially the growing **RFI** discussed throughout this paper – is unsurprising and underlines the 21st-century wisdom of bio-friendly ways forward.

*Reputed new fibre sources to remediate [\[a\]](#), may include power-over-Ethernet (POE) and some gigabit-router links.. Older BPL (broadband over powerlines) is a more obvious source.

► **ii Local governments** appear to be neglected by the inquiry (► 6th term of ref., “stakeholders”). Planning regulations in this field now appear to be so lightweight there is a possibility insensitive “permitted development” could abound, creating community distress, boding ill for the future. Therefore (► 2nd term of reference) do reflect how you/colleagues can make these regulations **more responsive to proper local input**, especially on cell sites, and also how **transparent public mapping** of proposed/existing antennas, including on street furniture, can be fully achieved.

► **iv Bio-testing light-based broadband**

a) Some UK optical communications researchers are already aware of its potential remarkable health-safety gains: to quote [Northumbria's](#) head of research “*LiFi could deliver additional benefits... including not exposing users to radiofrequency radiation.*” Barely absorbed by our surface tissue, it avoids the main cell- and tissue-polluting toxic effects found from RF across its spectrum in the mounting warning literature. *However*, to realise this potential, tests plus design-finessing are needed to exclude, for example, any subtle bio-electromagnetic interference along the optical nerve (given its feed into the brain), depending on the modulation used/polarity.

b) Do connect the dots and invite, e.g., Edinburgh's LiFi and Ophthalmology units to work together; ditto photo-biologists au fait with light-gated signalling in living tissue. Do at least screen for any effects on leaves/ microfauna/ vitamin D synthesis/ EZ water structure. *Modulated infrared* may need more care (ROS effects/shot noise) than visual light due to near-infrared tissue windows.

c) Compared to natural light, the colour spectrum of most **LED** lighting has large gaps and spikes that can detune our body clocks/parasympathetic nervous system: see pioneering light scientist Dr Alexander **Wunsch**, PhD. When policy-making for a beneficial future, optical broadband included, any British technical ventures to substantially reduce this disparity – and remove [flicker](#) – will have a winning wellbeing benefit for services and communities that deploy it.

► **v Chronic THz-gap risks** Old-paradigm expansion into chronic* **THz-gap** radiation, if permitted (specious short-range “6G”, edging above RF frequencies, with dense by-the-body transmitters) risks prolonging the “Dark Age” mindset, i.e. data provision at risk to our biology (= pollution with hidden costs). Serious neurological¹²⁷ and DNA/genotoxic risks^{128 129 130} are already emerging (also inflammation/ear drum risks^{131 132}) plus probable systemic toxic effects relayed via our skin.¹³³ Beyond medical/industrial diagnostics, where it is very useful, its scanning/chemical-reading properties look potentially intrusive. Sadly, it seems a push into THz-gap data spectrum could risk rash toxicity. It is time instead for mature, biological sensitivity appropriate for the 21st century.

*Short medical exposures are a separate category

► **vi International backlash** Because RF is emerging strongly as a systemic toxin, international consumer revulsion at invasive high-density RF transmitters (5G/IoT) and the rising net involuntary exposure (plus privacy erosion) these bring is inevitable: please welcome and support this gift to progress. “How can I protect my family in the light of the mounting precautionary science?” is one of many deserving questions that cannot be answered by RF-escalating rollouts, RF 5G included.

The more wholesome future such perceptive consumers ache to inhabit is being denied to them: not because new-paradigm non-RF approaches could not offer it, nor *greatly reward businesses who accelerate it in their evolution*, but because biocompatibility is being neglected, along with use of wiser, biologically based exposure standards such as [here](#). [134](#) [135](#) [136](#) Endless **RF IoT trivia**, if permitted, such as “toys”/food cartons transmitting to on-the-body Bluetooth (notice these warning papers [137](#) [138](#)) add cumulatively to the electromagnetic deterioration of human environments, intimate included: an incremental bioactive “smog”.

Who among us, during lockdown, has not taken pleasure from a pure unmediated moment in the sunshine? A **vast meta-analysis** found access to natural outdoor green spaces was powerfully equated with health. [139](#) The longings of much of humanity to lead an organic life (perhaps including, subconsciously, hyper-pixel-addicts with depression) deserve to be supported with non-invasive, non-polluting technologies. For many waking up to electromagnetic pollution – a gift for wise innovation and humane progress – that desired life is visibly a **non-transhumanist** one that respects the boundaries and sovereignty of our bodies. Bio-sensitive broadband/connectivity as set out in this paper, which also has *ethical respect for such boundaries* plus support for online/offline balance (**11/12g**), better fulfils such deep human longings/values, and points to a more genuinely wholesome future (see my British-led garden vision above **3**), including linked revenue streams

► **vi What might a clean, inspiring, future look like?**

A closing example to stimulate thinking –

Imagine a decade or two ahead where RF-EMFs still offer basic messaging-on-the-move (plus sparse LPWAN) but most towns/landscapes have begun to become less electromagnetically drilled and polluted than today, with some premium clean areas for biodiversity. Communications industries now enjoy far more income, as a proportion of their turnover, from non-RF capacity including fibre innovation (with good practice to avoid EMI), and, with a little ingenuity, our government does too – including from greatly reduced RF-related health costs. Sensitively used light-based broadband, with a firm foundation of bio-safety tests and resulting finessing, is in use with fibre in built environments and beyond. The combination has such generous data capacity that RF is now far less “needed” and devices are rapidly adapting / evolving to match.

RF/EMF functional disabilities (and RF-aggravated medium latency diseases) are however still widespread, due to mass past exposure to WiFi/LTE/linked devices etc. (now largely superannuated and retired, partly on health grounds) and early 5G to 2021, before the excesses of its full trajectory were wisely averted. But these disabilities are now better accommodated: something which has spurred wonderful creative innovation/adaptation (towards electromagnetic hygiene) so *benefitting everyone*, from prenatal to old age, due to the healthier sparkling environments we now inhabit.

With good data-fibre common indoors, there is now far less “falling down a Black Hole” behaviour outdoors (faces lost in screens/wearables, oblivious to beautiful surroundings) which is now seen as passé and unmindful (and inconsiderate of passive exposure, and relic RF is used). Our state meanwhile has some support programmes for any disadvantaged groups with gaming disorders etc., so supporting balanced lives.

At the same time, Britain is enjoying kudos and prosperity for being ahead on all this. Among other things, it has championed its gardening, cycling, walking, pet-loving, hands-on farming, crafts, cuisine, and sporting heritage – all vital to wellbeing as some jobs automate – and has the feet-on-the-ground sense and humour to say: yes we Brits enjoy some online time in proportion

but we've averted the worst hyper-addiction and are healthy as a result! A well-grounded, rounded, Britain that has relatively low need of surveillance (a virtuous circle) due to wellbeing.

Transhumanist trends have remained niche, their ethics under proper scrutiny (ditto risks of black-box AI) and are balanced by the timeless longings of much of our island nation – and much of humanity – to live an embodied organic life with access to unmediated living nature, i.e. our fabulous British patchwork landscapes, doorstep parks, and coasts.

Healthy, leafy, humorous Britain, which – having lifted itself by stages, 2021+, out of electromagnetic-pollution-overdrive (e.g. dense RF 5G/RF IoT) and having had some time to heal – is now a buoyant role model of wellbeing, envied by many nations, and is in holistic good shape.
