

Aantekenen

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Hooggeachte heer Wiebes,

Namens de stichting Stichting Stop5GNL ("**Stop5GNL**"), gevestigd te Amsterdam, wend ik mij tot u in verband met de voorgenomen 'uitrol' van 5G in Nederland.

Stop5GNL

Stop5GNL heeft ten doel het beschermen en bevorderen van de gezondheid van alle Nederlandse ingezetenen in zijn algemeenheid en in het bijzonder in verband met radiofrequente elektromagnetische straling.

Doel van deze brief

Deze brief gaat over de uitrol van 5G. Dit houdt kort gezegd in de door Agentschap Telecom (ressortterend onder uw departement) voorgenomen veiling van frequentiebanden voor mobiele communicatie, waarop de vijfde generatie mobiele netwerken (5G) in de nabije toekomst kan worden aangeboden. Dit zijn 700 MHz-, 1.400 MHz-, 2.100 MHz-, 3,5 GHz en 26 GHz-frequentiebanden. Bij brief van 5 december 2019 (kenmerk: DGBI / 19289009) heeft uw staatssecretaris de Tweede Kamer geïnformeerd over de start van de consultatie van regelgeving omtrent de frequentieveiling.

Stop5GNL is van mening dat de voorgenomen uitrol van 5G leidt tot een onaanvaardbaar gezondheidsrisico voor burgers van Nederland. Vele toonaangevende (onafhankelijke) wetenschappelijke onderzoeken wijzen uit dat elektromagnetische straling leidt tot gezondheidsrisico's. Zeker op de middellange en lange termijn. Vanwege de specifieke kenmerken van 5G zal het gezondheidsrisico na uitrol ervan aanmerkelijk toenemen. Stop5GNL acht het onrechtmatig als de Nederlandse Staat burgers aan deze gezondheidsrisico's blootstelt.

Stop5GNL roept u c.q. de Staat op om het proces tot uitrol van 5G te staken. In ieder geval tot het moment dat uit onafhankelijk (relevant) wetenschappelijk

onderzoek blijkt dat het gebruik van 5G in Nederland niet leidt tot wezenlijke gezondheidsrisico's op zowel de korte, middellange als lange termijn.

Deze brief dient tevens als uitnodiging voor overleg, zoals bedoeld in artikel 3:305a lid 2 Burgerlijk Wetboek (BW), over een vrijwillige staking van de frequentieveiling.

Toelichting

5G beslaat ten opzichte van haar voorgangers een nieuw frequentiebereik, te weten tussen de 30 en 300 GHz. Vanwege de hogere frequenties en doordat het bereik van 5G minder groot is, zullen veel meer antennes nodig zijn om een 5G veld te creëren. Dit leidt tot een grotere stralingsdichtheid. Zeker in dichtbevolkte gebieden.

De uitrol van 5G vloeit voort uit de TelecomCode (*Richtlijn 2018/1972 van het Europees Parlement en de Raad van 11 december 2018 tot vaststelling van het Europees wetboek voor elektronische communicatie*). Ter implementatie van de TelecomCode heeft u op 16 juli 2019 een concept wetsvoorstel (ter consultatie) gepubliceerd dat de uitrol van 5G in Nederland mogelijk moet maken. Het wetsvoorstel is (nog) niet aangenomen. Kort daarvóór publiceerde u de *Beleidsnota Mobiele Communicatie (11 juni 2019)*, waaruit duidelijk wordt op welke wijze u de uitrol van 5G in Nederland wilt vormgeven.

Zowel op Europees als nationaal niveau is de uitrol van 5G gedreven door economische motieven. De volksgezondheid is volgens de toelichtingen geen relevante afgewogen factor geweest. Ook zijn voorafgaand aan de beslissing tot uitrol van 5G geen relevante, onafhankelijke onderzoeken naar gezondheidsrisico's uitgevoerd (waarover hierná meer). Wel wordt door zowel de Europese wetgever als door u en uw staatssecretaris verwezen naar *Aanbeveling 1999/519/EG van de Raad van de Europese Unie*. Daarin beveelt de Raad aan de lidstaten aan om bij hantering van veiligheidsnormen aansluiting te zoeken bij de blootstellingsrichtlijnen voor elektromagnetische velden die zijn opgesteld door de *International Commission on Non-Ionizing Radiation Protection (ICNIRP)*.

Vooruitlopend op de uitrol van 5G en de benodigde wetswijzigingen wordt op verschillende plaatsen in Nederland getest met de mogelijkheden van 5G. Agentschap Telecom heeft daarvoor zogenaamde experimenteervergunningen verleend aan T-Mobile, KPN en Vodafone. Agentschap Telecom heeft zelf tussen februari en september 2019 op drie testlocaties veldsterktemetingen uitgevoerd om inzicht te krijgen in de elektromagnetische straling van 5G-antennes. Haar conclusie is dat de (op aanzienlijke afstand en relatief lage frequenties) gemeten veldsterktes binnen de blootstellingsrichtlijnen van ICNIRP blijven.

Gezondheidsrisico's

Vele toonaangevende en onafhankelijke (peer review) onderzoeken (o.a. *The Bio Initiative Report*, het *EU Reflex Report* en een recent *NTP Report*) tonen aan dat langdurige blootstelling aan elektromagnetische straling leidt tot onder andere tumoren in de hersenen en geslachtsdelen, onvruchtbaarheid, vermindering van de spermacellen en DNA, diabetes, autisme, leer- en geheugenstoornissen, adhd, depressies en een toename van Alzheimer. Daarbij lopen zwangere vrouwen en kinderen verhoogd risico.

Reeds in 2011 heeft het International Agency for Research on Cancer (IARC), onderdeel van de World Health Organization, uitgesproken dat de straling van mobiele telefoons en andere draadloze apparaten mogelijk kankerverwekkend is (categorie 2A). Rekening houdend met onzekerheden heeft het IARC mobiele zendsignalen beoordeeld als 'mogelijk kankerverwekkend bij mensen'.

Deze gezondheidsrisico's zijn gesignaleerd zonder dat (hoogfrequente) straling zoals aan de orde bij 5G in het onderzoek is betrokken.

Het gaat te ver om in het bestek van deze brief alle relevante studies te behandelen, hetgeen de reden is dat wordt verwezen naar het als **bijlage 1** aangehechte overzicht.

Vanwege de alom in de wetenschap gesignaleerde gezondheidsrisico's van blootstelling aan (hoogfrequente) elektromagnetische straling hebben 265 artsen en wetenschappers ernstige zorgen geuit over de gezondheidsrisico's van de uitrol van 5G. Dit wordt aangeduid als het *5G-appeal*. De oproep van de wetenschappers achter het 5G appeal is duidelijk (vertaald):

"Wij, ondergetekende wetenschappers, adviseren een moratorium op de uitrol van 5G, de vijfde generatie voor mobiele communicatie, totdat potentiële gevaren voor de menselijke gezondheid en het milieu volledig zijn onderzocht door wetenschappers onafhankelijk van de industrie. 5G zal de blootstelling aan radiofrequente elektromagnetische velden (RF-EMF) aanzienlijk verhogen bovenop de reeds bestaande 2G, 3G, 4G, WiFi enz. RF-EMF is bewezen schadelijk voor mens en milieu"

De wetenschappers die betrokken zijn bij het *5G-appeal* verwijzen naar het *EMF Scientist Appeal*, waarbij meer dan 252 wetenschappers uit 43 landen hun "*serious concerns*" hebben geuit over de volgende generatie mobiele netwerken. Het betreft een 'peer review' onderzoek op basis van recente wetenschappelijke onderzoeken waaruit ernstige gezondheidsrisico's als gevolg van blootstelling aan elektromagnetische straling naar voren zijn gekomen.

Opgeroepen is om een onafhankelijk onderzoek te doen naar de gevolgen van 5G-straling "om de veiligheid van de bevolking te garanderen". Vele wetenschappers vragen om de uitrol van het 5G-netwerk uit te stellen "tot de potentiële risico's voor de menselijke gezondheid en het milieu grondig onderzocht zijn door wetenschappers die onafhankelijk zijn van de industrie".

Op 6 december 2019 hebben Dr. ir. Inge-Willem Noordergraaf en Dr. Joel M. Moskowitz in De Telegraaf een gelijksoortige oproep gedaan. Zij worden als volgt geciteerd:

"We moeten ogenblikkelijk stoppen met de ontwikkeling van een 5G-netwerk. In tegenstelling tot wat door overheden en telecombedrijven wordt beweerd, zijn er veel aanwijzingen voor serieuze gezondheidsrisico's.

De telecomindustrie en de door hen betaalde experts proberen wetenschappers die de gezondheidseffecten van electromagnetische velden hebben onderzocht, te bestempelen als 'angstzaaiers'. Het is de verantwoordelijkheid van onafhankelijke wetenschappers om het grote publiek eerlijk en objectief te informeren."

Het regeringsstandpunt

Door de Tweede Kamer is tijdens Kamerdebatten aandacht gevraagd voor gezondheidsrisico's en het feit dat in de wetenschap (minst genomen) geen eensgezindheid bestaat over de gezondheidsrisico's van 5G (o.a. op 5 juni 2018). U heeft hierop in eerste instantie niet gereageerd.

Op 4 juli 2019 heeft de Tweede Kamer aangedrongen op onafhankelijk onderzoek naar de gezondheidsrisico's van 5G door de Gezondheidsraad. In reactie daarop heeft uw staatssecretaris erop gewezen dat geen negatieve gezondheidseffecten optreden als de internationale 'normen' (ICNIRP) worden aangehouden en zij heeft gerefereerd aan een ZonMW-onderzoeksprogramma.

Bij brief van 16 april 2019 hebben de minister van Volksgezondheid, Welzijn en Sport en u vragen van de vaste commissies over de uitrol van 5G beantwoord. Bij die beantwoording lag de nadruk op de economische groei en maatschappelijke ontwikkeling. Ten aanzien van mogelijke gezondheidsschade verwezen uw collega en u (wederom) naar internationale 'normen' (ICNIRP). Waar Kamerleden hebben gerefereerd aan vele studies waaruit blijkt dat sprake is van aanmerkelijke gezondheidsrisico's, hebben uw collega en u zonder nadere onderbouwing opgemerkt dat "er geen aanwijzingen zijn dat blootstelling aan radiofrequentie EMV door mobiele telefonie leidt tot gezondheidseffecten". Daarbij heeft u gerefereerd aan de visie van het Kennisplatform EMV, die op haar beurt heeft aangehaakt bij de blootstellingsrichtlijnen van ICNIRP.

Op 9 september 2019 heeft Kamerlid Van Raan aan de staatssecretaris van Volksgezondheid, Welzijn en Sport vragen gesteld over de schadelijkheid van 5G voor dieren en mensen. Bij brief van 2 oktober 2019 heeft de staatssecretaris laten weten dat de vragen niet binnen de gebruikelijke termijn kunnen worden beantwoord. Tot op heden zijn deze vragen niet beantwoord. De uitrol van 5G gaat echter onverminderd voort.

Weerlegging van het regeringsstandpunt

Volgens Stop5GNL is het regeringsstandpunt over de aan 5G verbonden gezondheidsrisico's onbegrijpelijk, onvoldoende op feiten gebaseerd en onvoldoende onderbouwd. Ten eerste omdat dit standpunt er niet van uitgaat dat 5G veilig is, maar ervan uitgaat dat onveiligheid niet is aangetoond. Bij die stand van zaken is de uitrol van 5G te beschouwen als experiment. Ten tweede is het regeringsstandpunt onbegrijpelijk omdat belangwekkende studies, waaruit vele en ernstige gezondheidsrisico's blijken, worden genegeerd. Ten derde omdat aan de door de regering aangehaalde richtlijnen en studies wezenlijke gebreken en bezwaren kleven. Hierna licht ik dat toe.

ICNIRP

De door ICNIRP opgestelde blootstellingsrichtlijnen, waarop uw regering wijst, zijn niet bindend voor de lidstaten. Lidstaten gaan hiermee verschillend om. Diverse lidstaten hanteren zelfs striktere richtlijnen (o.a. België, Bulgarije, Kroatië, Italië, Litouwen, Polen en Slovenië).

Op de door ICNIRP gepubliceerde blootstellingsrichtlijnen is in de wetenschap al sinds jaar en dag veel kritiek. Daarbij wordt onder andere gewezen op het volgende:

- de blootstellingsrichtlijnen van ICNIRP stammen uit 1998 en zijn verouderd. Destijds had niemand nog van 5G gehoord en sindsdien hebben innovaties en wetenschappelijke ontwikkelingen een grote sprong gemaakt. Zoals toegelicht, heeft 5G een veel hogere frequentie dan de in 1998 bestaande mobiele netwerken. Bovendien is met 5G sprake van een vele malen grotere stralingsdichtheid;
- ICNIRP heeft studies die DNA-beschadiging aantonen, studies die laten zien dat elektromagnetische straling vrije radicalen aanmaakt in het lichaam en studies die effecten op de mannelijke vruchtbaarheid aantonen (doelbewust) niet in haar visie betrokken;
- de ICNIRP- blootstellingsrichtlijnen zijn uitsluitend gebaseerd op onderzoeken naar acute opwarmingseffecten ofwel thermische gevolgen (acute gevolgen bij meer dan één graad temperatuurverhoging van het lichaam bij een bestraling van 6 of 30 minuten). Hierbij is geen aandacht besteed aan veranderingen in non-thermische (niet aan warmte gerelateerde) cel-fysiologische processen. Juist die processen leiden volgens

een scala aan onafhankelijke studies tot gezondheidsrisico's (op langere termijn);

- de blootstellingsrichtlijnen van ICNIRP zijn gebaseerd op wetenschappelijk vastgestelde effecten die tijdens of kort na blootstelling kunnen optreden. Enig risico op gezondheidsschade op de middellange of langere termijn is door ICNIRP niet in het onderzoek betrokken;
- tot slot geldt dat (grote) vraagtekens kunnen worden geplaatst bij de onafhankelijkheid van de leden van ICNIRP. Zij hebben veelal belangen bij telecommunicatiebedrijven.

Zowel het Europees Parlement als de Raad van Europa zijn tot het inzicht gekomen dat de door ICNIRP geformuleerde blootstellingsrichtlijnen (onder andere) om vermelde redenen niet adequaat zijn en aanpassing behoeven. Zij hebben daarom in Resolutie 2008/2211 respectievelijk een Advies van 6 mei 2011 over gezondheidsrisico's in verband met elektromagnetische velden (nr. 12608) de aanbeveling gedaan aan de lidstaten om de op de ICNIRP adviezen gebaseerde normen te verlagen.

In dit licht is het merkwaardig en in ieder geval onjuist dat uw regering de ICNIRP-blootstellingsrichtlijnen als relevante norm in de standpuntbepaling heeft betrokken.

Gezondheidsraad

De Gezondheidsraad heeft in 2011 een rapport gepubliceerd over de invloed van radiofrequente telecommunicatiesignalen op kinderhersenen. Conclusie van de Gezondheidsraad is dat geen bewijs is gevonden dat blootstelling aan elektromagnetische velden een negatieve invloed heeft op de ontwikkeling en het functioneren van de hersenen van kinderen. Tekenend is dat de Gezondheidsraad reeds op de eerste pagina van haar rapport opmerkt: "*Over het optreden bij kinderen van mogelijke andersoortige, op lange termijn optredende effecten, zoals het ontstaan van hersentumoren, kan de commissie bij gebrek aan gegevens geen uitspraken doen.*"

Bij brief van 5 november 2019 heeft de Tweede Kamer aan de Gezondheidsraad verzocht om een advies uit te brengen over de mogelijke gezondheidsrisico's in relatie tot 5G. Dit onderzoek is (nog) niet afgerond, maar het traject van uitrol van 5G gaat onder uw verantwoordelijkheid (niettemin) voort.

Programma Elektromagnetische Velden en Gezondheid van ZonMw

ZonMw voert sinds 2006 het Programma Elektromagnetische Velden en Gezondheid, dat zich richt op alle relevante velden (0 – 300GHz) en technologisch, biologisch, sociologisch en epidemiologisch onderzoek betreft. In 2015 heeft ZonMw een tussenevaluatie afgerond, die op 23 september 2015 naar de Tweede Kamer is gestuurd. Dit onderzoek was gericht op gezondheidsschade op de korte en middellange termijn. De lange termijn is hierin – wederom en kennelijk doelbewust

– niet betrokken. Niettemin is een aanzienlijk aantal wezenlijke gezondheidsrisico's gesignaleerd.

Internationaal onderzoeksbureau Technopolis heeft een onafhankelijke evaluatie gedaan naar het ZonMw onderzoek. Technopolis heeft geconcludeerd dat in feite geen conclusies kunnen worden verbonden aan het ZonMw onderzoek (beperkte opzet, geen duidelijke wetenschappelijke vraag en geen samenhang tussen onderzoeken).

Kennisplatform EMV

Volgens het Kennisplatform EMV, waarnaar uw regering verwijst, zijn bij onderzoeken wél aanwijzingen gevonden voor een verhoogde kans op twee soorten hersentumoren bij veelvuldig en langdurig gebruik van een mobiele telefoon, maar de "*betekenis van deze aanwijzingen*" is volgens het Kennisplatform EMV vooralsnog niet duidelijk. (Ook) het Kennisplatform EMV gaat dus expliciet niet uit van (bewezen) veiligheid van 5G.

Het Kennisplatform EMV stelt bovendien expliciet dat niet is uitgesloten dat in de toekomst gezondheidseffecten worden gevonden die optreden onder het niveau van de door ICNIRP opgestelde blootstellingsrichtlijnen. Het gaat dan om mogelijke effecten van blootstelling op lange termijn. Deze effecten zijn in vele onafhankelijke studies reeds aangetoond.

Resumé

Vele (onafhankelijke en relevante) wetenschappelijke studies wijzen op grote en ernstige gezondheidsrisico's door blootstelling aan elektromagnetische straling, (met name) ook (ver) onder de ICNIRP- blootstellingsrichtlijnen. Wetenschappers wijzen onder andere op het risico op verschillende kankersoorten.

Uw regering baseert zich voor de beslissing om de uitrol van 5G, ondanks deze gezondheidsrisico's, door te zetten op onderzoeken waaraan wezenlijke gebreken en bezwaren kleven. De Gezondheidsraad en Kennisplatform EMV wijzen bovenal op mogelijke gezondheidsrisico's op de langere termijn. Enig onderzoek daarnaar door of in opdracht van de regering is niet uitgevoerd dan wel afgerond. Onderzoek door de Gezondheidsraad is nog gaande.

Onrechtmatig handelen

Op basis van de hiervóór geschetste stand van de wetenschap is het maatschappelijk onzorgvuldig en daarmee onrechtmatig om de uitrol van 5G voort te zetten en daarmee burgers bloot te stellen aan ernstige gezondheidsrisico's. Dit is bovendien in strijd met fundamentele (mensen)rechten. Hieronder wordt dat toegelicht.

De op de Staat rustende positieve zorgplicht en het voorzorgsbeginsel

Op de Staat rust de verplichting om de gezondheid van haar burgers zoveel als mogelijk (actief) te waarborgen. Dit volgt onder andere uit de artikelen 168 lid 1 en 191 lid 1 VWEU, de artikelen 2 lid 1 en 8 lid 1 EVRM, artikel 2 lid 1 en artikel 6 Handvest van de grondrechten van de EU, artikel 6 Handvest van de grondrechten van de Europese Unie, artikel 24 lid 1 Internationaal Verdrag inzake de Rechten van het Kind en de artikelen 21 en 22 van de Grondwet.

Kort gezegd, volgt uit deze verdrags- en wetsbepalingen dat de Staat die maatregelen dient te nemen die noodzakelijk én voldoende zijn om burgers effectief te beschermen. Onder meer nadat zij vanwege wetenschappelijke onderzoeken op de hoogte raakt van risico's die het recht op leven in gevaar brengen. Daarbij spelen volgens rechtspraak onder meer de intensiteit en duur van een blootstelling of overlast mee in combinatie met de duur van de gevolgen voor de mentale en fysieke gezondheid van burgers.

Deze op de Staat rustende positieve zorgplicht wordt mede ingevuld door het 'voorzorgsbeginsel'. Dit beginsel brengt met zich mee dat de Staat in het geval van een potentieel dreigend gevaar voor (o.a.) de volksgezondheid maatregelen moet nemen om mens en omgeving te beschermen tegen risico's die nog onzeker zijn, maar wel mogelijk schade kunnen brengen. Uitdrukkelijk ook binnen de overheid dient het voorzorgsbeginsel leidend te zijn voor de (beleidsmatige) omgang met onzekere risico's. Juist waar het gaat om nieuwe technologieën. Zo hebben de Wetenschappelijke Raad voor het Regeringsbeleid (rapport: '*Onzekere veiligheid, verantwoordelijkheden rond fysieke veiligheid*') en de Gezondheidsraad (rapport: '*Voorzorg met Rede*') in 2008, op aanvraag van het kabinet, de aanbeveling gedaan om het voorzorgsbeginsel ten grondslag te leggen aan het beleid bij nieuwe technologieën. Het kabinet heeft dit destijds onderschreven.

De Raad van Europa heeft in zijn resolutie 1815 uit 2011 over de gezondheidsrisico's van elektromagnetische straling bevestigd dat "*wachten op hogere niveaus van wetenschappelijke en klinische bewijzen alvorens te handelen om welbekende risico's te voorkomen, kan leiden tot zeer hoge kosten op het vlak van gezondheid en economie, zoals het geval is geweest met het asbest, loodhoudende brandstof en tabak.*"

Maatschappelijk onzorgvuldig handelen

Waar een overheid ten onrechte geen toepassing geeft aan het voorzorgsbeginsel, kan sprake zijn van onrechtmatig handelen. Of daarvan sprake is, zal onder andere afhangen van de vraag hoe groot de kans op schade is, de ernst van de voorzienbare schade en de mogelijkheid c.q. bezwaarlijkheid van te nemen voorzorgsmaatregelen. Dit zijn de zogenaamde 'Kelderluikcriteria', afkomstig uit het Kelderluikarrest van de Hoge Raad (ECLI:NL:HR:1965:AB7079). Daarbij geldt dat

ook een kleine kans op ernstige schade volgens vaste rechtspraak van de Hoge Raad al kan nopen tot het treffen van voorzorgsmaatregelen.

Toegesplitst op de voorgenomen uitrol van 5G geldt dat minst genomen sprake is van wetenschappelijke onzekerheid over de gezondheidsrisico's die aan 5G kleven, terwijl een (zeer) groot aantal studies grote en ernstige gezondheidsrisico's (op de middellange en lange termijn) aantonen of in ieder geval suggereren. Uit géén enkele studie blijkt dat elektromagnetische straling – zeker met een intensiteit zoals bij 5G – zonder gevaar voor de volksgezondheid is, terwijl de door uw regering ingeroepen richtlijnen en studies zijn verouderd en behept met andere bezwaren en gebreken.

Onder deze omstandigheden, onder deze stand van de wetenschap en zonder deugdelijk onderzoek zijdens de regering, dient de Nederlandse Staat zich te onthouden van alle gedragingen die de uitrol van 5G bevorderen en dient zij alles te doen om de uitrol van 5G te voorkomen. Doet de Staat dit niet dan stelt zij de Nederlandse bevolking bloot aan een onaanvaardbaar gezondheidsrisico en dat is onrechtmatig.

Gevorderde verbod

Stop5GNL heeft als belangenorganisatie die opkomt voor het beschermen en bevorderen van de gezondheid recht en belang bij het voorkomen van een onrechtmatige situatie zoals hiervóór geschetst.

Indien de regering niet vrijwillig voldoet aan de (hierna te formuleren) oproep om de uitrol van 5G te staken, ziet Stop5GNL geen andere mogelijkheid dan een verbod daartoe in rechte af te dwingen. Daarbij zal worden gevorderd om 1) de veiling van de voor 5G bestemde frequenties te staken en gestaakt te houden en 2) al datgene te doen dat mogelijk is om de uitrol van 5G tegen te houden tot uit onafhankelijk en relevant wetenschappelijk onderzoek blijkt dat hieraan geen gezondheidsrisico's kleven.

Indien de regering niet de verantwoordelijkheid neemt voor de gezondheid van burgers, ook voor de komende generaties, dan zal aan de rechter worden verzocht om daarop in te grijpen.

Oproep en uitnodiging tot overleg

Gelet op het vorengaande, roep ik u namens Stop5GNL op om de uitrol van 5G – voor dit moment specifiek de veiling van de voor 5G bestemde frequenties – te staken en gestaakt te houden tot het moment dat uit onafhankelijk en relevant wetenschappelijk onderzoek voldoende overtuigend blijkt dat hieraan geen gezondheidsrisico's kleven. Graag ontvang ik **binnen veertien dagen** na

ontvangst van deze brief de bevestiging dat u en uw regering aan deze oproep gevolg zullen geven.

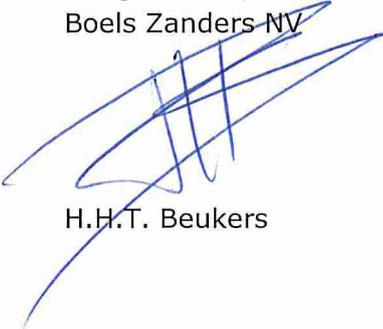
Voor het geval u de gevraagde bevestiging niet (tijdig) geeft, doe ik hierbij namens Stop5GNL een verzoek tot overleg zoals bedoeld in artikel 3:305a BW. Dit overleg heeft tot doel om te bespreken of uw regering bereid is om (alsnog) tegemoet te komen aan hetgeen waartoe wordt opgeroepen. Graag verneem ik **binnen veertien dagen** na ontvangst van deze brief of u bereid bent tot dit overleg. Daarbij vertrouw ik erop dat, bij een positieve reactie hierop, daadwerkelijk bereidheid bestaat om te bezien of de uitrol van 5G kan worden gestaakt hangende nadere wetenschappelijke onderzoeken.

Indien u op beide hiervóór vermelde onderwerpen afwijzend antwoordt, ontvang ik graag verhinderdata voor de komende zes weken van u en de advocaat die de belangen van de Staat zal behartigen. Dit in verband met een te entameren kort gedingprocedure. Voor nu vertrouw ik erop dat het zover niet hoeft te komen.

Tot slot

De minister van Volksgezondheid, Welzijn en Sport, Agentschap Telecom en de vaste commissies EKZ en VWS ontvangen een afschrift van deze brief.

Hoogachtend,
Boels Zanders NV



H.H.T. Beukers

Bijlage 1

If it has on one occasion defensibly been scientifically proven that there is a damaging effect or risk of damage, then the fact that ten other defensible trials did not show such an effect or risk is irrelevant. It is then merely up to the scientific community to clarify why the ten defensible trials did not show what is scientifically proven, in order to better understand why and how the damages occur or could occur.⁵

This point can be illustrated at the hand of swan populations: If one study shows that black swans exist, then it is not relevant that ten other studies did not find any black swans. It has been proven that the black swan exists, and it may be useful to determine why the ten other studies did not yield the same results.⁶

It would be misleading if one were to attempt a “statistical average calculation” and in such a manner conclude that there is but a 1/11 chance that the black swan actually exists, as its existence has been shown in only one study, whilst ten others found no such proof.

1.2.2. Humans: Health damages and hazards.

1.2.2.1. DNA damage.

In 2015, a scientific review of the then more than 100 accessible peer-reviewed studies regarding the so-called “oxidative effects” of low intensity radiofrequent radiation (hereafter: RFR) was undertaken.

The review (Yakymenko et al., 2015⁷) showed e.g. that it was plausible that EHS-like⁸ conditions were in part caused by exposure to low intensity RFR (p. 195) and that the exposure could lead to cancer (p. 196), both of which are caused by “oxidative stress”. It was thus found that 93% of studies showed that such radiation led to the forming of reactive oxidative connections in all investigated living organisms, from cells, plants, insects, lab animals to humans (sperm), (cf. ibid. p. 186).

Yakymenko et al. (2015, p. 186) continues thus:

“All above mentioned studies dealt with the effects of low-intensity RFR. This means that the intensity of radiation was far below observable thermal effects in biological tissues, and far below safety limits of the International Commissions on Non-Ionizing Radiation Protection (ICNIRP) (ICNIRP, 1998).”⁹

Ibid. (p. 187):

“Low-intensity RFR is referred to as radiation with intensities which do not induce significant thermal effects in biological tissues. Accordingly, any intensity of RFR under the ICNIRP limits can be referred to as low-intensity. In this paper we will analyze only the effects of low-intensity RFR.”

⁵ In the same vein, Philips et al. (2009) published an article titled “*Electromagnetic fields and DNA damage*” in the scientific journal “*Pathophysiology*,” no. 16, pp. 79 – 88. They state that “*Each study to investigate RFR-induced DNA damage must be evaluated on its own merits, and then studies that both show effects and do not show effects must be carefully evaluated to define the relationship of experimental variables to experimental outcomes and to assess the value of experimental methodologies to detect and measure these outcomes (see Section 2)*” (p.85)

⁶ The example has been used by e.g. the philosopher of science Karl Popper.

⁷ Published in 2016 in the scientific journal “*Electromagnetic Biology and Medicine*”, no. 35, pp. 186 – 202.

⁸ EHS stands for Electro Hyper Sensitivity, and is a physical condition in which a person displays a series of symptoms when they are near equipment which emits electromagnetic radiation, often termed “electric over-sensitivity”.

⁹ These limits are mentioned further in item 2.1 below.

They conclude (ibid., p. 196) that:

"...a broad biological potential of ROS and other free radicals, including both their mutagenic effects and their signaling regulatory potential, makes RFR a potentially hazardous factor for human health. We suggest minimizing the intensity and time of RFR exposures, and taking a precautionary approach towards wireless technologies in everyday human life."

On November 15th 2017, the US-based researcher-driven "BioInitiative 2012 – A Rationale for Biologically-based Exposure Standard for Low-Intensity Electromagnetic Radiation" published a review of 200 then available studies on the effect of radiofrequent electromagnetic radiation on free radicals, which provoke so-called "oxidative stress," cf. the mention of Yakymenko et al. (2015) in the above.

The review showed that in 180 of the 200 studies (90%) there was a statistically significant effect, whilst the last 20 (10%) did not report any statistically significant effect.

In May 2018, Martin Pall¹⁰ ascertained that at the time there existed a minimum of 21 scientific studies (since 1971) that documented DNA damage caused by radiofrequent electromagnetic radiation, and that these led to chromosome damage and other mutations.

Further, he ascertained that there was a minimum of 19 studies (since 1981) that documented the causation of free radicals and oxidative stress by this radiation¹¹.

The REFLEX-study (2004) was conducted by 12 research institutions on behalf of the EU, with a budget of 3 million euro. The results included that fact that at the specific absorption rate (hereafter SAR) of 1,3 W/kg (i.e. below the ICNIRP guidelines recommendation of 2,0 W/kg for the body and head, cf. item 2.1. below), there was a significant increase of DNA damage (p. 109):

"RF-EMF exposure at a SAR of 1.0 W/kg and below had no effect on Comet formation in HL-60 cells (expressed as Olive Tail Moment OTM) as compared to control and sham-exposed cells. On the other hand RF-EMF at SAR of 1.3 W/kg and above caused a significant increase in DNA strand breaks. The maximum of this effect was observed at SAR 1.3 W/kg (OTM = 2.20 ± 0.16) and 1.6 W/kg (2.24 ± 0.10)."

Further, this radiation rate was the one that produced the greatest effect on DNA (p. 119, repeated on p. 222):

"...were applied following RF-field exposure of HL-60 cells at that exposure condition with the most significant effect on DNA integrity (1800 MHz, continuous wave, 1.3 W/kg, 24h)."

Ibid. (p. 223, section 5.2.1., lab participant 2, conclusion 9):

"Within the investigated SAR energy ranges RF-EMF under the in-vitro conditions used are genotoxic in HL-60 cells without affecting cell-cycle distribution cell proliferation or cell

¹⁰ PhD, prof. emeritus in biochemistry and Basic Medical Sciences, Martin L. Pall "5G: Great risk for EU, US and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them" (2018, pp. 6 – 8).

¹¹ Ibid., pp. 11 – 12.

progression.”

Ibid. (conclusion 10):

“The partial-body SAR for any 10-gram tissue like for example the head as exposed region to mobile phone electromagnetic fields should not exceed 2 W/kg according to the Radio-Radiation Protection Guidelines. Notably, our findings on genotoxic effects of RF-fields in HL-60 cells have been shown for SAR levels below these acceptable partial-body SAR levels.”

Ibid. (p. 223, section 5.2.2., lab participant 3):

“Our results imply a genotoxic action of RF-EMFs below proposed radiation safety levels.”

However, it was also concluded (p. 226) that since these were “only” lab tests, the REFLEX-study was not in itself enough to draw the conclusion that the (still) employed limits posed a danger to human health, though the study made such a conclusion more likely. Further, it was concluded that:

“Furthermore, there exists no justification anymore to claim, that we are not aware of any pathophysiological mechanisms which could be the basis for the development of functional disturbances and any kind of chronic diseases in animal and man.”

Beyond the REFLEX-study, it appears that over 40 studies that show DNA damage as a result of exposure to radiofrequent electromagnetic radiation have been conducted¹².

These include, e.g.:

Burlaka et al (2013), *“Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation.”*¹³, p. 223:

“In conclusion, the exposure of developing quail¹⁴ embryos in ovo to extremely low intensity RF-EMR of GSM 900MHz during at least one hundred and fifty-eight hours discontinuously leads to the significantly increased rates of superoxide and nitrogen oxide generation in embryo cells. This was accompanied by a significantly increased level of lipid peroxidation, a depression of key antioxidant enzymes activity, and significantly, 2–3-fold, increased level of oxidative damage of DNA in embryo cells.”

Blank og Goodman (2011), *“DNA is a fractal antenna in electromagnetic fields.”*¹⁵, p. 411:

“Since DNA can interact with EMF over a wide range of frequencies, and does not appear to be limited to an optimal frequency, it has the functional properties of a fractal antenna.

...

¹² A documentation list is attached to this legal opinion as Appendix 1.

¹³ Published in 2011 in the scientific journal “International Journal of Radiation Biology” vol. 87, no. 4, pp. 409-15.

¹⁴ It is common to use animals to assess health risks to humans, and to use such studies as the basis for guidelines and limits, cf. e.g. Engels et al. (2014), “*Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird*” (Nature, vol. 509), p. 354: “...animal studies are commonly used to evaluate human health risks and have contributed to guidelines for human exposures...”. In a written reply dated February 20th 2019, the (Danish) Environmental Protection Agency stated the same and referred to the European Chemicals Agency with the following link <https://echa.europa.eu/da/information-on-chemicals/biocidal-active-substances>

¹⁵ Published in the scientific journal “Experimental Oncology,” vol. 35, no. 3, pp. 219 – 225.

From the above analysis of the effect of EMF on the stress response, DNA strand breaks and cancer epidemiology, the fractal property of DNA is apparent in the ELF and RF ranges.

...

Electron transfer is a plausible mechanism for EMF interactions with DNA at higher frequencies where higher energies are involved. The damage due to DNA strand breaks that occur at higher frequencies, including ionising radiation, is generally attributed to oxidation, another chemical name for electron transfer. Because of the greater energy at higher frequencies, reactive oxygen species, such as peroxides, contribute to the DNA damage. However, DNA strand breaks occur over a wide range of frequencies, and do not demonstrate frequency optima related to molecular reaction kinetics." (Emphasis added.)

It is further stated in the currently employed guidelines for human exposure to radiofrequent electromagnetic radiation (cf. item 2.1 below) (p. 413):

"...The existing 100 mT ELF exposure limit set by ICNIRP (International Commission for Non-Ionizing Radiation Protection) is many times higher than the 0.4 mT where a doubling of childhood leukemia risk is widely acknowledged. It has also been pointed out that the specific absorption rate (SAR), the widely used thermal standard for EMF safety, does not relate at all to the biological thresholds of the stress response in the ELF and RF ranges, and that the threshold for the same biological process differs by many orders of magnitude in the two ranges (Blank and Goodman 2004)."

Phillips et al (2009), "Electromagnetic fields and DNA damage."¹⁶, p. 85:

"RFR exposure does indeed appear to affect DNA damage and repair, and the total body of available data contains clues as to conditions producing effects and methodologies to detect them.

...

The lack of a causal or proven mechanism(s) to explain RFR-induced effects on DNA damage and repair does not decrease the credibility of studies in the scientific literature that report effects of RFR exposure, because there are several plausible mechanisms of action that can account for the observed effects. The relationship between cigarette smoking and lung cancer was accepted long before a mechanism was established. ..."

Panagopoulos (2019), "Comparing DNA damage induced by mobile telephony and other types of man-made electromagnetic fields"¹⁷, p. 53 (abstract):

"The number of studies showing adverse effects on living organisms induced by different types of man-made Electromagnetic Fields (EMFs) has increased tremendously. Hundreds of peer reviewed published studies show a variety of effects, the most important being DNA damage which is linked to cancer, neurodegenerative diseases, reproductive declines etc. Those studies that are far more effective in showing effects employ real-life Mobile Telephony (MT) exposures emitted by commercially available mobile phones..." (Emphasis added.)

The investigation further ascertains that characteristics other than merely signal strength are significant causes of the damaging effects (cf. *ibid.*):

"...The crucial parameter for the intense bioactivity seems to be the extreme variability of the

¹⁶ Published in 2009 in the scientific journal "Pathophysiology," no. 16, pp. 79 – 88.

¹⁷ Published in 2019 in the scientific journal "Mutation Research-Reviews in Mutation Research," no. 781, pp. 53 – 62.

polarized MT signals, mainly due to the large unpredictable intensity changes.”

Ibid. (p. 60, conclusion):

“The importance of exposure variability shown in the present study implies the need to define EMF-exposures not only by frequency components and average intensity values, but by reporting maximum and minimum intensity as well, frequency variations, pulsing or continuous wave, modulation, and - of course - polarization.”

Ibid. (pp. 59 – 60, conclusion):

“It comes that variability in the EMF exposure is an extremely important factor in order for the specific type of polarized EMF to be able to induce biological/health effects.

...

The extreme and unpredictable variability of the real-life MT signals that apparently seems to be the reason for the corresponding intense bioactivity, does not concern only the 2nd generation (GSM) MT signals tested in our experiments and in the present review, but all existing types of digital MT signals (2nd, 3rd, 4th generation), and all types of modern digital microwave telecommunication signals/EMFs (DECT phones, Wi-Fi routers, etc.), since they all operate under the same principles combining RF carrier signals with ELF pulsing and modulation of similar frequency bands, emitting variable information each moment which in turn makes the emission variable in intensity, frequency, waveform etc. In fact, with every new generation of telecommunication devices (e.g. 3rd, 4th, 5th generation mobile phones or base antennas) the amount of information transmitted each moment (speech, text, images, video, internet, etc.) is increased, resulting in higher variability and complexity of the signals with the living cells/ organisms even more unable to adapt. The result of the recent study that found a real 3rd generation (UMTS) MT EMF to be more bioactive than real 2nd generation (GSM) MT EMF emitted by the same device [36] is in line with this fact.” (Emphasis added.)

D'Silva et al. (2017)¹⁸, the study cited as reference [36] in the above, contains the following description of its results and conclusions, cf. the corresponding abstract:

“Results: *In our study, the exposure of developing chick embryos to 2G and 3G cell phone radiations caused structural changes in liver in the form of dilated sinusoidal spaces with haemorrhage, increased vacuolations in cytoplasm, increased nuclear diameter and karyorrhexis and significantly increased DNA damage.*

Conclusion: *The chronic exposure of chick embryo liver to RFR emitted from 2G and 3G cell phone resulted in various structural changes and DNA damage. The changes were more pronounced in 3G experimental group. Based on these findings it is necessary to create awareness among public about the possible ill effects of RFR exposure from cell phone.”*

Regarding the method employed, the study states the following (ibid., p. 6):

“A popular brand cell phone hand set and a service provider were used for network connection for both 2G and 3G exposure. For exposure activation, the cell phone was rung from another cell phone for duration of three minutes each, every half an hour, with the first exposure given at 12th hour of incubation (4.30 am-4.30 pm). The total exposure for a 12 hour period was 75 minutes followed by 12 hour of exposure-free period. This was repeated daily up to 12th day of incubation.”

The study further referenced that:

¹⁸ Published in July 2017 in the scientific journal “Journal of Clinical and Diagnostic Research,” vol. 11, no. 7, pp. 5 – 9.

“Non-thermal stress is more deleterious than thermal stress and is known to cause oxidative stress [5], production of free radicals [6], structural changes in plasma membrane [7], changes in ionic transport [8] and also increased DNA damage [9].”

1.2.2.1.1. Subject conclusion.

There is clear scientific documentation that radiofrequent electromagnetic radiation, including at levels below the limits employed in Denmark, cf. item 2.1 below, causes DNA damage to both humans and animals.

Panagopoulos (2019) states that not only the strength of radiation is significant to the expected damage. Further, the findings will also be applicable to 5G, owing to the commonalities between the technologies.

1.2.2.2. Cancer.

1.2.2.2.1. Classification.

The IARC (International Agency for Research on Cancer) is the WHO’s agency for cancer research.

In 2011 the agency classified electromagnetic radiation as “possibly carcinogenic to humans”.¹⁹

A later scientific review published in November 2018 concluded that according to the IARC criteria, there is sufficient basis for classifying electromagnetic radiation as “carcinogenic to humans”²⁰, reasoned with the referral to a review of a series of investigations conducted prior to that time.

Miller et al. (November 2018²¹, p. 674):

“...Analysis of a subset of cases (58% of all cases) based on operator-recorded information showed significant brain cancer risks for children with a significant trend of increase in risk with increasing years of use. Based on children’s memory of both ipsilateral and contralateral use there were significant increased risk of brain cancer along with a marginal increase of risk with an increasing number of calls...”

Ibid. (p. 675):

“Carlberg and Hardell (2013) also reported that persons diagnosed with a glioblastoma multiforme (GBM) exposed to RFR²² emanating from WTDs²³ had a significantly shorter survival period than those without such exposures.”

Ibid. (p. 676):

“Coureau et al. (2014) reported on a French national study of mobile phone use and brain tumors (glioma and meningioma) between 2004 and 2006.

... There was a marginal increase in risk with increasing hours of use ($p_{trend}=0.07$). A small

¹⁹ Cf. IARC monograph vol. 102, 2013, p. 419, item 6.3.

²⁰ A so-called “class 1-classification” in the IARC system.

²¹ Published in November 2018 in the scientific journal “Environmental Research,” no. 167, pp. 673 – 683.

²² Radiofrequency radiation, cf. *ibid.*, p. 673.

²³ Wireless Transmitter Devices, cf. *ibid.*, p. 673.

number of urban users showed a significant 8-fold increased risk for brain tumors excluding temporal or frontal lobes (OR²⁴ 8.2. 1.37–49.07). The authors commented: 'Finally, we observed increased OR for urban use for gliomas, a result inconsistent with the hypothesis of a higher RF power output during calls in rural areas, documented by some Swedish study. However, our results are consistent with a recent international study showing no difference between rural and urban exposition in most countries except in Sweden, and a Hardell study when considering gliomas separately.'

Ibid. (p. 676):

"Momoli et al. (2017) undertook a re-analysis of the Canadian data from the 13-country case-control Interphone Study (2001–2004).

...
For glioma, when comparing those in the highest quartile of use (> 558 lifetime hours) to those who were not regular users, the odds ratio was 2.0 (95% confidence interval: 1.2, 3.4). After adjustment for selection and recall biases, the odds ratio was 2.2 (95% limits: 1.3, 4.1), thus allaying concerns that bias could explain the positive findings in the Interphone study."

Ibid. (p. 676):

"Akhavan-Sigari et al. (2014) reported that patients with glioblastoma multiforme who had used cellphones ≤ 3 h per day had better survival than those with cellphone use of ≥ 3 h per day.

...
This study shows that genetic changes, compatible with carcinogenic effects, result from higher exposure to RFR.²⁵

Ibid. (p. 676):

"Carlberg and Hardell (2015) performed a pooled analysis from 1997 to 2003 and 2007–2009 of the risk of meningioma from cell and cordless phone use. In total, 1625 meningioma cases and 3530 controls were analyzed. Overall no association with use of mobile or cordless phones was found. However, they reported an increased risk among heavy users of both mobile and cordless phones from various wireless phone types (wireless combines all phone types) (Table 11). The risk increased significantly per 100 h of use from four wireless phones categories."

Ibid. (p. 677):

"Hardell et al. (2013a) pooled acoustic neuroma results from case-control studies conducted in 1997–2003 and 2007–2009, including 316 participating cases and 3530 controls. ... There is some evidence of a dose-response relationship is evident with mobile and cordless phones associated with ORs of 4.5 and 6.5 respectively for 20 or more years of use. There were similar results per cumulative hours of use (Table 12)."

Ibid. (p. 677):

"Moon et al. (2014), in a matched case-control study from Korea examining 119 cases of vestibular schwannoma and 238 controls attending for routine examinations in the same institution found no difference between cases and controls in the duration, time of use or cumulative use of mobile phones. However, in a case-case analysis they found that vestibular Schwannoma tumor volume was greater in those with higher use compared to lower use of mobile phones and in those with regular compared to non-regular use (Table 13)."

²⁴ Odds ratio, cf. *ibid.*, p. 674.

²⁵ The patients in the study (63 adults; 38 M 25 F) were operated on due to cancer tumours, between 2008 and 2011, cf. Akhavan-Sigari et al., 2014, p. 117.

Ibid. (p. 678):

"Zada et al. (2012) examined data from three major U.p. cancer registries: Los Angeles County, California Cancer Registry, and the National Cancer Institute's Surveillance, Epidemiology and End Result for 12 U.p. states (SEER 12) from 1992. The APC for GBM (grade IV glioma) and Glioma was reported by brain region. Table 17 shows APC changes by cancer registry for GBM and for glioma located in three anatomical regions of the brain, showing significant increases compatible with increasing use of mobile phones.

Consistent with the study above, Cardis et al. (2011) reported that the combined percentage of the total radiation absorbed by the frontal lobe (19%), the temporal lobe (50%) and the cerebellum (18%) was 81% at 900 MHz and was 86% at 1800 MHz (frontal lobe 14%, temporal lobe 50%, cerebellum 13%)."

Ibid. (p. 679):

"7. Case series

West et al. (2013) reported multiple²⁶ primary breast cancers in young women who had regularly placed a cellphone in their bras (Table 20). Tumors were reported to have occurred subcutaneously directly under the antennas of the phones. Subsequently, a number of other such cases have come to light with unusually located breast tumors relative to reported cell phone storage in the bra.

Peleg (2012) discussed a cancer cluster among young workers at an Israeli Antenna Range Facility. It was believed that significant RFR exposures took place as a result of workplace conditions. Five of about 30 workers were diagnosed with cancer. This was regarded as significantly greater than the expectation. Peleg et al. (2018) extended this analysis to 47 patients with cancer previously exposed to whole-body prolonged RFR, mainly from communication equipment and radar. They found that the percentage frequency of haemolymphatic (HL) cancers in the case series was very high, at 40% with only 23% expected for the series age and gender profile, 95% confidence interval: 26–56%, $p < 0.01$; 19 out of the 47 patients had HL cancers.

Stein et al. (2011) studied 56 cancers among 49 military personnel (47 male, 7 females) exposed to intense prolonged RFR between 1992 and 2011. Based on exposure information reconstructed from reported histories, it was assumed that significant RFR exposures took place as a result of workplace conditions. The average duration of exposure was 13 years; the average age at diagnoses was 43. There appeared to be an excess of both haemolymphatic and testicular cancers."

Ibid. (p. 680, discussion):

"Nevertheless²⁷, recent case-control studies from Sweden and France corroborate findings of earlier studies in providing support for making a causal connection between cell phone use and brain cancer, as well as acoustic neuroma, also called Vestibular Schwannoma. Hardell and Carlberg (2013) concluded that the Bradford Hill criteria for causality have now been fulfilled. It is notable that three recent meta-analyses all confirm significant increased risk of glioma after 10 or more years of use of cell phones (Bortkiewicz et al., 2017; Prasad et al., 2017; Yang et al., 2017). The Aydin et al. (2011) data that relied on billing records along with children's recall of their uses of phones approaches and in some instances met conventional tests of statistical significance and indicated that four years or more of heavy cell phone radiation causes glioma in children. This finding is consistent with that of Hardell and Carlberg (2015) who showed that those who began using cell phones and/or cordless phones regularly as children had between 4 and 8-fold increased risk of glioma as adults."

²⁶ Four patients aged 21, 21, 33 and 39, cf. *ibid.*, Table 20.

²⁷ In the article itself, the quote follows a review of usual reservations made in connection with the various, common research methods, which have likewise been used in the studies referred to in the article.

Ibid. (p. 680, discussion):

"Potential cancer sites and other outcomes for consideration in new studies include... Other sites than brain and acoustic neuroma could potentially increase in incidence when untested whole-body exposure occurs, this may be the case with several evolving technologies....other possible sources of exposures that have not been evaluated include areas close to cellular base station antennas, the yet-to-be introduced 5 G communication systems, and rapidly evolving occupational exposure and novel systems for Wi-Fi (Peleg, 2009)."

Ibid. (p. 681, discussion):

"There are indications particularly from the Ramazzini animal studies that other environmental exposures might make people more susceptible to a combination of exposures (Falcioni et al., 2018). This combinatorial issue been noted in studies of occupational exposure to chemicals, metals and electromagnetic fields (Navas-Acien et al., 2002). Separately, no effects were observed but when combined with EMF strong results were found. In the Ramazzini studies finding a synergistic interaction between RFR and ionizing radiation, RFR served as a promoter while in the NTP animal studies RFR served as a direct carcinogen and genotoxic agent (National Toxicology Program, a, b, 2018.)."

Ibid. (p. 681, discussion):

"Individual hypersensitivity to electric and radiofrequency fields (EHS) is a relatively newly reported phenomenon in the west, although cases of radiation sickness have been found in the former Soviet literature from the 1960s and 1970s. Case studies and individual reports together identify a population which would benefit from RFR exposure reduction (Davis et al., 2017). Because of serious methodological difficulties in operationalizing the concept and a lack of investment in research, definitive epidemiological studies of EHS have not yet been conducted."

Ibid. (p. 681, discussion):

"However, non-cancer outcomes such as sperm damage, hearing loss and loss of visual acuity are likely to be more commonly linked to mobile phone use."

Ibid. (p. 681, conclusions):

"The Epidemiological studies reported since the 2011 IARC Working Group meeting are adequate to consider RFR as a probable human carcinogen (Group 2 A). However, they must be supplemented with the recently reported animal data as performed at the Ramazzini Institute and the US National Toxicology Program as well as by mechanistic studies. These experimental findings together with the epidemiology reviewed here are sufficient in our opinion, to upgrade the IARC categorization of RFR to Group 1, carcinogenic to humans.

...
In light of the evolving science concerning mobile phone and screen time exposures and the longer-term risk of cancer established by both epidemiological and toxicological studies, current evidence is strong enough to go from precaution concerning possible risk to prevention of known risks.

...
The precautionary principle should be applied now and suitable warning messages provided to adults and critically to children and their parents.

...
experimental evaluations and modeling are essential before distributing newer systems (e.g. 5 G) for which no safety data have been obtained. The absence of systematic testing of such technologies should not be confused with proof of safety.

...
In the meantime, the evidence amassed thus far from epidemiology strengthens the case for

instituting the precautionary principle with respect to exposures to RFR, especially to young children and men and women that wish to reproduce. ... Where studies have been carried out on human sperm quantity and quality there are increasing indications of serious human health impacts. To ignore those findings and subject humans to unevaluated novel RFR frequencies places current and future generations at risk." (Emphasis added.)

1.2.2.2.2. Further.

A long list of other scientific studies confirm that exposure to radiofrequent electromagnetic radiation (including below the levels stipulated in Denmark's currently employed guidelines, cf. item 2.1 below) can be carcinogenic. Some of them are:

Blank og Goodman (2011), *"DNA is a fractal antenna in electromagnetic fields."*²⁸, p. 411:

"Regarding the connection between EMF and the incidence of cancer, the different EMF energy levels in the non-ionising and ionising ranges all involve interaction with and activation of DNA and induction of protein synthesis. The ability of EMF to cause DNA strand breaks and damage to proteins in the non-ionising range is similar to the destructive effects on DNA of the much more energetic X-rays and gamma rays in the ionising ranges, where it is generally acknowledged that the cancers are due to DNA damage. The recent epidemiology studies in the non-ionising range link EMF-caused changes in DNA with cancer. Additional support comes from the study showing that the absence of DNA repair genes is associated with a greater incidence of leukemia from exposure to low frequency EMF (Yang et al. 2008)." (underlined here)

Lerchl et al (2015), *"Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans"*, p. 585 (abstract):

"...Since many of the tumor-promoting effects in our study were seen at low to moderate exposure levels (0.04 and 0.4 W/kg SAR), thus well below exposure limits for the users of mobile phones, further studies are warranted to investigate the underlying mechanisms. Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones."

Yakymenko et al. (2015), cf. item 1.2.1. above) showed e.g. that low intensity RFR could lead to cancer (p. 196).

Prasad et al (2017), *"Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes."*²⁹, p. 808 (conclusion):

"In our review of the literature and meta-analysis of case-control studies, we found evidence linking mobile phone use and risk of brain tumours especially in long-term users (>10 years). We also found a significantly positive correlation between study quality and outcome in the form of risk of brain tumour associated with use of mobile phones. Higher quality studies show a statistically significant association between mobile phone use and risk of brain tumour. Even

²⁸ Published in the scientific journal "Experimental Oncology," vol. 35, no. 3, pp. 219 – 225.

²⁹ Published in 2017 in the scientific journal "Neurological Sciences," vol. 38, pp. 797 – 810.

the source of funding was found to affect the quality of results produced by the studies.”

This is a systematic, scientific review of the then current research that found a clear basis for linking the use of mobile phones to cancer tumours in the brain.

Further, the review in question found that the studies that had the highest scientific quality were the same as those finding the link, and that the source of financing had also played a part in the quality of the studies.

In November 2018, the American National Institute of Health published a report titled “Toxicology and Carcinogenesis Studies in Hsd:Sprague Dawley SD Rats Exposed to Whole-Body Radio Frequency Radiation at a Frequency (900 MHz) and Modulations (GSM and CDMA) Used by Cell Phones,” which states (p. 125 – 126, conclusions):

“GSM-Modulated RFR

*Under the conditions of this 2-year whole-body exposure study, there was clear evidence of carcinogenic activity*³⁰ of GSM-modulated cell phone RFR at 900 MHz in male Hsd:Sprague Dawley SD rats based on the incidences of malignant schwannoma of the heart. The incidences of malignant glioma of the brain and benign, malignant, or complex pheochromocytoma (combined) of the adrenal medulla were also related to RFR exposure. The incidences of benign or malignant granular cell tumors of the brain, adenoma or carcinoma (combined) of the prostate gland, adenoma of the pars distalis of the pituitary gland, and pancreatic islet cell adenoma or carcinoma (com-bined) may have been related to RFR exposure. There was equivocal evidence of carcinogenic activity of GSM-modulated cell phone RFR at 900 MHz in female Hsd:Sprague Dawley SD rats based on the incidences of schwannomas of the heart.*

...

CDMA-Modulated RFR

Under the conditions of this 2-year whole-body exposure study, there was clear evidence of carcinogenic activity of CDMA-modulated cell phone RFR at 900 MHz in male Hsd:Sprague Dawley SD rats based on the incidences of malignant schwannoma of the heart. The incidences of malignant glioma of the brain were also related to RFR exposure. The incidences of adenoma of the pars distalis of the pituitary gland and adenoma or carcinoma (combined) of the liver may have been related to RFR exposure. There was equivocal evidence of carcinogenic activity of CDMA-modulated cell phone RFR at 900 MHz in female Hsd:Sprague Dawley SD rats based on the incidences of malignant schwannoma of the heart, malignant glioma of the brain, and benign, malignant, or complex pheochromocytoma (combined) of the adrenal medulla. Increases in nonneoplastic lesions of the heart, brain, and prostate gland in male rats, and of the brain in female rats occurred with exposures to CDMA-modulated RFR at 900 Mhz.” (Emphasis added.)

On the immediate transference of these results onto humans, it further states (ibid., p. 125):

“The malignant schwannomas of the heart observed in male rats in the current studies and the malignant gliomas observed in the brain of male rats, arise from the same cell type as the acoustic neuromas (vestibular schwannomas) observed in humans, though in a different location. This lends credence to the possible association of these tumors with cellular phone use. The cellular origin of malignant gliomas in the rat brain is unclear, but they do arise from glial cells (support cells in the brain), as do human glioblastomas, so it is possible that such an association exists for these tumors as well. However, the interpretation of these findings with

³⁰ The asterisk refers to p. 16 of the study, in which the standards of proof are more clearly defined. “Clear evidence” is defined as “...studies that are interpreted as showing a dose-related (i) increase of malignant neoplasms, (ii) increase of a combination of malignant and benign neoplasms, or (iii) marked increase of benign neoplasms if there is an indication from this or other studies of the ability of such tumors to progress to malignancy.”

respect to specific risks to humans from cellular telephone use is beyond the scope of the current studies. Further efforts to characterize the molecular basis by which RFR elicits its effects in rats, and a more complete assessment of the exposure conditions in the current studies in relation to exposures to humans from cellular telephone technologies should provide con-text to aid understanding of the implications of the current findings to human health.” (Emphasis added)

Falcioni et al. (2018), “Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission”³¹, p. 496 (abstract):

“The RI³² findings on far field exposure³³ to RFR are consistent with and reinforce the results of the NTP study³⁴ on near field exposure, as both reported an increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users. These experimental studies provide sufficient evidence to call for the reevaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans.” (Emphasis added.)

The study continues (cf. *ibid.*, p. 501):

“...The statistically significant increase in the incidence of heart Schwannomas observed in male rats in the late part of their life, both in the RI and NTP studies, are consistent with the epidemiological findings, where the highest increase in risk of vestibular Schwannoma among humans exposed to RFR was observed in men over 50 years of age with the highest cumulative exposure (Hardell et al., 2013, 2003).”

The trial was conducted in such a manner that the exposed animals were subjected to a radiation absorption estimated to be between 0,001 and 0,3 W/kg (cf. p. 499), which is significantly lower than the limits permitted in Denmark, at 2 W/kg, cf. item 2.1 below.

The statistically significant results occurred in the groups of rats exposed to a field strength of 50 V/m. This is below the limit of 58,34 V/m, which is currently used in Denmark for a frequency of 1,8 GHz, cf. item 2.1 below.

In May 2018, Martin Pall³⁵ ascertained that at the time there existed a minimum of 35 scientific studies (since 1978) that documented that radiofrequent electromagnetic radiation was carcinogenic.

Panagopoulos (2019), cf. item 1.2.1. above, likewise referred to “hundreds of peer reviewed articles” demonstrating a range of effects from electromagnetic fields, including cancer (p. 53).

³¹ Published in 2018 in the scientific journal “Environmental Research”, vol. 165, pp. 496 – 503.

³² RI stands for “Ramazzini Institute,” the research institute where the investigation took place.

³³ Far field exposure in this case implies that the study recreated the conditions for radiation with a 1.8 GHz mobile phone mast, cf. *ibid.*, p. 497, item 2.1.

³⁴ The “NTP-study” is the immediately above mentioned from the American “National Health Institute”.

³⁵ Dr Pall is prof. emeritus in biochemistry and basic medical sciences, and published “5G: Great risk for EU, US and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them” (pp. 15 – 16).

The (Danish) Minister of Health, in her reply dated April 12th 2019 to question 693 in the Danish parliament's Health and Elderly Committee, presented figures from the Danish Health Registry's cancer registry, which show a clear increase in registered cases of cancer, in the form of glioblastoma, within the last 20 years.

The increase is particularly noticeable from 2005 to 2006 in individuals more than 30 years of age, and on average shows a doubling of the number of cases in this age range in the period from 2006 to 2017, compared to the preceding period from 1995 to 2006.

Altogether, there is an almost 80% increase in occurrences from 2015 to 2017, compared with the general level prior to 2006.

Tabel 1 Antal incidente tilfælde af Glioblastom, 1995-2017

Kilden : Cancerregisteret			
Udtrækskriterier :			
Der er trukket på :			
Glioblastom ICD03-morfologi = 94403			
og Giant cell glioblastom ICD03-morfologi =			
Antal			
aar	<= 30 år	>30 år	I alt
1995	9	143	152
1996	11	133	144
1997	<5	176	
1998	8	200	208
1999	8	169	177
2000	<5	173	
2001	6	156	162
2002	9	163	172
2003	<5	185	
2004	7	174	181
2005	<5	174	
2006	<5	221	
2007	<5	196	
2008	6	237	243
2009	<5	252	
2010	<5	271	
2011	<5	253	
2012	9	250	259
2013	7	280	287
2014	<5	292	
2015	10	311	321
2016	7	300	307
2017	<5	288	

Kilde: Cancerregisteret, 2019

Anm.: Tal under fem er angivet med < 5 af hensyn til diskretionering og summen for i alt er i disse tilfælde fjernet

Anm.: Opdelt i kollerer mindre eller lige end 30 år, større end 30 år og i alt

The same doubling tendency is documented in England, cf. Philips et al. (2018), "Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995–2015 Suggests an Adverse Environmental or Lifestyle Factor,"³⁶ which states the following (p. 1, abstract):

"Results. We report a sustained and highly statistically significant ASR³⁷ rise in glioblastomamultiforme (GBM) across all ages. The ASR for GBM more than doubled from 2.4 to 5.0, with annual case numbers rising from 983 to 2531. Overall, this rise is mostly hidden in the overall data by a reduced incidence of lower-grade tumours. Conclusions. The rise is of importance for clinical resources and brain tumour aetiology. The rise cannot be fully accounted for by promotion of lower-grade tumours, random chance or improvement in

³⁶ Published in 2018 in the scientific journal "Journal of Environmental and Public Health," article ID 7910754.

³⁷ Age Standardised Rate.

diagnostic techniques as it affects specific areas of the brain and only one type of brain tumour. Despite the large variation in case numbers by age, the percentage rise is similar across the age groups, which suggests widespread environmental or lifestyle factors may be responsible." (Emphasis added.)

In the Netherlands, an increase of 20% over a 21-year period, from 1989 to 2010, is documented, cf. Vincent et al. (2014), "Changing incidence and improved survival of gliomas,"³⁸ p. 2311:

"The incidence rate of glioma increased from 4.9 per 100,000 inhabitants in 1989 to 5.9 in 2010..."

1.2.2.3. Other health damages to humans.

In their article "Systematic Derivation of Safety Limits for Time-Varying 5G Radiofrequency Exposure Based on Analytical Models and Thermal Dose," Neufeld and Kuster (2018) ascertained that even at brief exposures to radiation corresponding to the planned 5G-radiation using higher frequencies and/or changed modulation, etc., cf. item 1.1. above, tissue damage to humans is possible, cf. p. 705, 706 and 711:

"Extreme broadband wireless devices operating above 10 GHz may transmit data in bursts of a few milliseconds to seconds. ...these bursts may lead to short temperature spikes in the skin of exposed people. ... To stay consistent with the current safety guidelines, safety factors of 10 for occupational exposure and 50 for the general public were applied. ... The results also show that the peak-to-average ratio of 1,000 tolerated by the International Council on Non-Ionizing Radiation Protection guidelines may lead to permanent tissue damage after even short exposures, highlighting the importance of revisiting existing exposure guidelines.

...
THE FIFTH generation of wireless communication technology (5G) promises to facilitate transmission at data rates up to a factor of 100 times higher than 4G. For that purpose, higher frequencies (including millimeter-wave bands), broadband modulation schemes, and thus faster signals with steeper rise and fall times will be employed, potentially in combination with pulsed operation for time domain multiple access. 5G is designed as a ubiquitous communication system spanning applications such as high-bandwidth mobile data and telephony, real-time machine-to-machine communication (e.g., autonomous mobility), and the Internet of Things (IoT). Exposure to radiofrequency (RF) radiation from wireless devices to large radar installations and medical equipment can result in increases in body core temperature or cause localized temperature rises, with the potential for adverse health effects. The thresholds for frequencies above 10 MHz set in current exposure guidelines (ICNIRP 1998; IEEE 2005, 2010) are intended to limit tissue heating.

...
However, short pulses can lead to important temperature oscillations, which may be further exacerbated at high frequencies (>10 GHz, fundamental to 5G), where the shallow penetration depth leads to intense surface heating and a steep, rapid rise in temperature...

...
The recommendations in the ICNIRP guidelines limit the power density during short pulses to 1,000 times the limit for the time-averaged incident power density. The IEEE standard limits the radiant exposure (energy absorption per unit area) during any 100 ms to one-fifth of the total radiant exposure for the whole averaging time. The physical or biological rationales for these limits, however, are not provided.

...
Laakso et al. (2017) ... The authors conclude that the current guidelines do not adequately prevent excessive heating from pulsed exposure, as peak temperatures can easily exceed the

³⁸ Published in 2014 in the scientific journal "European Journal of Cancer," vol. 50, pp. 2309 – 2318.

mean temperature by more than a factor of 3 and suggest that radiant exposure limits be introduced.

Morimoto et al. (2017) ... They conclude that the thermal time constants can be as short as 30 s for narrow-beam exposures and that short pulses can carry enough energy to cause injuries;

...

Another conclusion of this study is that the current ICNIRP (1998) and IEEE (2005, 2010) guidelines urgently need to be revised, as the duty cycle of 1,000 currently tolerated can produce unacceptable temperature increases that may result in permanent tissue damage. ..." (Emphasis added.)

Cindy Russell (2018), "5 G wireless telecommunications expansion: Public health and environmental implications", p. 485:

"There are no long term exposure guidelines, nor are there guidelines for low level, non-thermal or biological effects considered in the International Commission on Non-Ionizing Radiation Protection (ICNIRP) standards which are the basis for standards used worldwide..."

Ibid. (p. 491):

"Although 5G technology may have many unimagined uses and benefits, it is also increasingly clear that significant negative consequences to human health and ecosystems could occur if it is widely adopted. Current radiofrequency radiation wavelengths we are exposed to appear to act as a toxin to biological systems. A moratorium on the deployment of 5G is warranted, along with development of independent health and environmental advisory boards that include independent scientists who research biological effects and exposure levels of radiofrequency radiation.

...

Public health regulations need to be updated to match appropriate independent science with the adoption of biologically based exposure standards prior to further deployment of 4G or 5G technology."

In May 2018, Martin Pall³⁹ ascertained that the following further kinds of health damage could result due to radiofrequent electromagnetic radiation on humans:

- reduced fertility and sex drive, increased spontaneous abortions, etc. (18 studies since 1971);
- neurological/neoropsychiatrial effects (25 studies since 1966);
- apoptosis/cell death (13 studies since 1971);
- hormonal effects (12 studies since 1971); and
- increased levels of intracellular calcium ions, causing a range of diseases (15 studies since 1988).

Pall (ibid., p. 1 – 2) stated:

"Each of these effects is produced via the main mechanism of action of microwave/lower frequency EMFs, activation of voltage-gated calcium channels (VGCCs) (Chapter 2). Each of them is produced via what are called downstream effects of VGCC activation. It follows from this that we have a good understanding not only that these effects occur, but also how they can occur. The extraordinary sensitivity of the VGCC voltage sensor to the forces of the EMFs

³⁹ Dr Pall is prof. emeritus in biochemistry and basic medical sciences, and published "5G: Great risk for EU, US and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them," pp. 8 - 15.

tells us that the current safety guidelines allow us to be exposed to EMF levels that are something like 7.2 million times too high. That sensitivity is predicted by the physics. Therefore, the physics and the biology are each pointing to the same mechanism of action of non-thermal EMFs. The different effects produced are obviously very deep concerns. They become much deeper and become existential threats when one considers that several of these effects are both cumulative and eventually irreversible.

...
Obviously 4G and 5G will make the situation much worse." (Emphasis added.)

1.2.2.4. Particulars regarding children and cancer or other health damages.

There exists a series of studies, some of which are mentioned above, which specifically refer to health damage and risks of cancer or other adverse effects on children, such as:

Divan et al. (2012), "Cell phone use and behavioural problems in young children,"⁴⁰ (p. 524 abstract):

"The findings of the previous publication were replicated in this separate group of participants demonstrating that cell phone use was associated with behavioural problems at age 7 years in children, and this association was not limited to early users of the technology. Although weaker in the new dataset, even with further control for an extended set of potential confounders, the associations remained."

This investigation, which was a repetition of a previous investigation undertaken by the same scientists, confirmed a connection between behavioural problems with children aged 7 and the prenatal use of mobile phones by the mother as well as the children's own use postnatally, without it being possible to determine with certainty that there was a causal link, cf. p. 529. The investigation thus confirmed a potential risk.

Birks et al (2017), "Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts"⁴¹, p. 1 (abstract, script version):

"Overall, 38.8% of mothers, mostly from the Danish cohort, reported no cell phone use during pregnancy and these mothers were less likely to have a child with overall behavioral, hyperactivity/inattention or emotional problems. Evidence for a trend of increasing risk of child behavioral problems through the maternal cell phone use categories was observed for hyperactivity/inattention problems (OR for problems in the clinical range: 1.11, 95%CI 1.01, 1.22; 1.28, 95%CI 1.12, 1.48, among children of medium and high users, respectively). This association was fairly consistent across cohorts and between cohorts with retrospectively and prospectively collected cell phone use data." (Emphasis added.)

Ibid. (p. 13 conclusion, script version):

"Maternal cell phone use during pregnancy may be associated with an increased risk of behavioral problems, particularly hyperactivity/inattention problems, in the offspring. This is the largest study to date to evaluate these associations and to show mostly consistent results across cohorts with retrospectively and prospectively assessed maternal cell phone use. Still, the interpretation of these results is unclear and should take into consideration that uncontrolled confounding by social factors or maternal hyperactivity may influence both

⁴⁰ Published in 2012 in the scientific journal "Journal of Epidemiology and Community Health," vol. 66, no. 6, pp. 524 – 529.

⁴¹ Published in 2017 in the scientific journal "Environment International," vol. 104, pp. 122 – 131.

maternal cell phone use and child behavioral problems.”

The result is thus reserved, though consistent, in confirming that there could be an increased risk of health problems for children due to their mothers' use of mobile phones during pregnancy.

Sudan et al (2018), *“Maternal cell phone use during pregnancy and child cognition at age 5 years in 3 birth cohorts”*⁴², p. 155 (abstract):

“We observed patterns of lower mean cognition scores among children in relation to high frequency maternal prenatal cell phone use. The causal nature and mechanism of this relationship remain unknown.”

There is a row of related tests on animal foetuses, e.g.:

Jing et al (2012), *“The influence of microwave radiation from cellular phone on fetal rat brain”*, p. 64:

“In order to protect human’s health from the microwave damage, the relevant radiation limits have been given by many countries. The current limited guidelines for microwave from cellular phone in U.p. and Europe are 1.6 W/kg and 2.0 W/kg, respectively. New lower limits should also be used for children and/or pregnant women.

Due to the proximity of cellular phone antenna to the user’s ear and head, the brain is inevitably exposed to EMFs with a relatively high specific absorption ratio (SAR), so the potentially danger from EMFs has been a concern of more and more people, especially by pregnant women.

...

As a whole, the results obtained in the present study indicate that exposure to EMFs of cellular phone (SAR 0.9 W/kg) could induce modifications in the fetal rat brain, not only oxidative stress system but also neurotransmitters. Because of the widespread use of cellular phones, further investigations with complementary techniques will be necessary to understand the mechanism of relation between EMFs of cellular phone and physiological implications.”

It is noted that the radiation absorption rate is below the 2 W/kg limit currently employed in Denmark, cf. item 2.1 below.

Megha et al (2015), *“Low intensity microwave radiation induced oxidative stress, inflammatory response and DNA damage in rat brain”*⁴³, p. 164 (conclusion):

“In conclusion, prolonged exposure to low intensity microwave radiation at frequencies 900, 1800 and 2450 MHz leads to oxidative stress and inflammatory imbalances which subsequently leads to DNA damage in brain. These findings suggest that microwave radiation induced oxidative stress and inflammatory imbalances may be the causative factors involved in causing DNA strand breaks in brain cells.”

Aldad et al (2012), *“Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated*

⁴² Published in 2018 in the scientific journal “Environment International,” vol. 120, pp. 155 – 162.

⁴³ Published in 2015 in the scientific journal “NeuroToxicology” vol. 51, pp. 158 – 165.

*Cellular Telephones Affects Neurodevelopment and Behavior in Mice*⁴⁴, p. 2 and 6:

"Overall, the mice exposed in-utero to radiation were hyperactive, had decreased memory, and decreased anxiety.

...

Our findings indicated significant electrophysiological and behavioral changes in mice exposed in-utero to radiation. The significant trend between the groups treated for 0, 9, 15, and 24 hours/day demonstrates that the effects are directly proportional to usage time, and suggests that safety limits, particularly for pregnant women, can be established. Though it is difficult to translate these findings to human risks and vulnerability, we identify a novel potential contribution to the increased prevalence in hyperactive children, one that is easily prevented. However, it is important to note that hyperactivity and anxiety are closely related and may confound one another.

...

In summary, we demonstrate that fetal radiofrequency radiation exposure led to neurobehavioral disorders in mice. We anticipate these findings will improve our understanding of the etiology of neurobehavioral disorders. The rise in behavioral disorders in developed countries may be, at least in part, due to a contribution from fetal cellular telephone radiation exposure. Further testing is warranted in humans and non-human primates to determine if the risks are similar and to establish safe exposure limits during pregnancy."

Buchner og Eger (2011), *"Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields—A Long-term Study under Real-life Conditions"*⁴⁵, p. 1 (translated from German):

"Since the 1960s, occupational studies on workers with continuous microwave radiation exposures (radar, manufacturing, communications) in the Soviet Union have shown that RF radiation exposures below current limits represent a considerable risk potential. A comprehensive overview is given in the review of 878 scientific studies by Prof. Hecht, which he conducted on behalf of the German Federal Institute of Telecommunications (contract no. 4231/630402) (2, 3).

As early as the 1980s, US research projects also demonstrated in long-term studies that rats raised under sterile conditions and exposed to "low-level" RF radiation showed signs of stress by increased incidences of endocrine tumors..."

Further, *ibid.* (p. 9, summary of results):

"...dopamine levels decrease substantially after the exposure begins. Even after one and a half years, the initial levels are not restored. Six months after the activation of the transmitter, PEA levels decrease continuously over the entire exposure period. Only in the exposure group above 100 $\mu\text{W}/\text{m}^2$ is this effect observed immediately. All findings were observed well below current exposure limits (14)." ⁴⁶

Also, *ibid.* (p. 12, epidemiological evidence):

"As part of the German Mobile Telecommunication Research Programme, approximately 3000 children and adolescents were studied in Bavaria for their individual cell phone radiation exposure levels in relation to health problems. Among the various data sets, the data set

⁴⁴ Published in 2012 in the scientific journal "Nature Scientific Reports" 2, article no. 312. In 2013, a corrigendum (article no. 1320) was issued, with no changes to the article's conclusions.

⁴⁵ Originally published in German in 2011 in the scientific journal "Umwelt-Medizin-Gesellschaft," vol. 24, no. 1, pp. 44 – 57.

⁴⁶ (14) is the scientists' referral to the ICNIRP-guidelines, cf. item 2.1 below.

regarding behavioral problems showed a significant increased risk for both adolescents (OR: 3.7, 95%-CI: 1.6-8.4) and also children (OR: 2.9, 95%-CI: 1.4-5.9) in the highest exposure group (56). For the first time, the "Rimbach Study" provides a model of explanation in biochemical terms. "

Sudan et al (2012), "Prenatal and Postnatal Cell Phone Exposures and Headaches in Children."⁴⁷, p. 1 (abstract, script version):

"In this study, cell phone exposures were associated with headaches in children, but the associations may not be causal given the potential for uncontrolled confounding and misclassification in observational studies such as this. However, given the widespread use of cell phones, if a causal effect exists it would have great public health impact."

Byun et al (2013), "Mobile Phone Use, Blood Lead Levels, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study"⁴⁸, p. 1:

"The results suggest that simultaneous exposure to lead and RF from mobile phone use was associated with increased ADHD symptom risk, although possible reverse causality could not be ruled out."

Herbert and Sage (2013), "Autism and EMF? Plausibility of a pathophysiological link part II ", p. 211 (abstract):

"Autism spectrum conditions (ASCs) are defined behaviorally, but they also involve multileveled disturbances of underlying biology that find striking parallels in the physiological impacts of electromagnetic frequency and radiofrequency radiation exposures (EMF/RFR).

...

Brain oxidative stress and inflammation as well as measures consistent with blood-brain barrier and brain perfusion compromise have been documented. Part II of this paper documents how behaviors in ASCs may emerge from alterations of electrophysiological oscillatory synchronization, how EMF/RFR could contribute to these by detuning 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, detuning of the brain and organism, with autistic behaviors as emergent properties emanating from this pathophysiology.

...

All of these phenomena also occur with EMF/RFR exposure that can add to system overload ('allostatic load') in ASCs by increasing risk, and can worsen challenging biological problems and symptoms; conversely, reducing exposure might ameliorate symptoms of ASCs by reducing obstruction of physiological repair.

...

With dramatic increases in reported ASCs that are coincident in time with the deployment of wireless technologies, we need aggressive investigation of potential ASC—EMF/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." (Emphasis added.)

⁴⁷ Published in 2012 in the scientific journal "The Open Pediatric Medicine Journal," no. 6, pp. 46 – 52.

⁴⁸ Published in March 2013 in the scientific journal "PLOS One," d. 21.

Wart et al. (2008)⁴⁹ ascertained, using models of heads, that children's heads absorbed around twice as much radiation as adults, cf. p. 3693:

"...The comparisons have also shown that the maximum SAR in 1 g of peripheral brain tissues of child models aged between 8 and 15 is comparable to the maximum SAR in 1 g of peripheral brain tissues of adult models while it is about two times higher for child models aged between 5 and 8. This is certainly due to the smaller thicknesses of pinna, skin and skull. ... The results obtained in this study need to be confirmed since they have been derived from data sets of limited size. Nevertheless these results are comparable to those obtained in other studies involving several phantoms (Beard et al 2006, Kainz et al 2005). ..."

Hardell et al (2011), "Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects"⁵⁰, p. 1465 (abstract) found:

"...an increased risk was found for glioma and use of mobile or cordless phone. The risk increased with latency time and cumulative use in hours and was highest in subjects with first use before the age of 20."

From Miller et al november 2018, p. 676 – 677:

"In a population-based case-control study of children Li et al. (2012) included 939 leukemia and 394 brain neoplasm⁵¹ cases newly diagnosed between 2003 and 2007, aged 15 years or less.

...

They reported that a higher than median averaged APD⁵² was significantly associated with an increased Adjusted Odds Ratio (AOR) for all neoplasms (1.13; 1.01–1.28), and for leukemia (1.23; 0.99–1.52), but not for all brain neoplasms (1.14, 0.83–1.55). They did not specifically analyze data on gliomas."

Ibid., (p. 681, conclusions):

"The precautionary principle should be applied now and suitable warning messages provided to adults and critically to children and their parents. Until technology has been devised that substantially lowers exposures, special efforts should be advanced to ensure that the exposures of children are limited to those deemed essential. Children should be encouraged to text to reduce their exposure to RFR, while every attempt should be made to reduce exposure to RFR in schools, as well as homes."

1.2.2.5. Subject conclusion.

It seems clearly and scientifically well documented that exposure to radiofrequent electromagnetic radiation (also below the limits currently used in Denmark, cf. item 2.1 below)

⁴⁹ Published in 2008 in the scientific journal "Physics in Medicine & Biology," vol. 53, no. 13, pp. 3681 – 3695.

⁵⁰ Published in 2011 in the scientific journal "International Journal of Oncology", vol. 38, no. 5, pp. 1465 – 1474.

⁵¹ Neoplasms are abnormal tissues which can develop into tumours, and in the worst case malignant cancer tumours.

⁵² Stands for "Average Power Density", cf. ibid. p. 677.

can be carcinogenic, and in this respect pose a health risk to humans, a health risk that could prove life threatening.

Further, Pall's (2018) summarised scientific documentation of a range of further kinds of damage, including reduced fertility, spontaneous abortions, neurological/neuropsychiatric effects, etc., can be added to this.

Further, it must be concluded that children are especially vulnerable and that several studies point to a possible connection between exposure to radiofrequent electromagnetic radiation and behavioural difficulties, autism, reduced perception, etc.

1.2.3. Animals.

Regarding animals, reference can be made to, e.g. Alfonso Balmori's review of the scientific literature in "*Electromagnetic pollution from phone masts. Effects on wildlife*,"⁵³ p. , where the conclusions (regarding birds, mammals and insects):

"This literature review shows that pulsed telephony microwave radiation can produce effects especially on nervous, cardiovascular, immune and reproductive systems [111]:

- *Damage to the nervous system by altering electroencephalogram, changes in neural response or changes of the blood-brain barrier.*
- *Disruption of circadian rhythms (sleep-wake) by interfering with the pineal gland and hormonal imbalances.*
- *Changes in heart rate and blood pressure.*
- *Impairment of health and immunity towards pathogens, weakness, exhaustion, deterioration of plumage and growth problems.*
- *Problems in building the nest or impaired fertility, number of eggs, embryonic development, hatching percentage and survival of chickens.*
- *Genetic and developmental problems: problems of locomotion, partial albinism and melanism or promotion of tumors.*

In the light of current knowledge there is enough evidence of serious effects from this technology to wildlife. For this reason precautionary measures should be developed, alongside environmental impact assessments prior to installation, and a ban on installation of phone masts in protected natural areas and in places where endangered species are present. Surveys should take place to objectively assess the severity of effects."

1.2.3.1. Birds.

There is a larger number of scientific investigations which document direct damage or the risk thereof on birds (and consequently also their habitats if, e.g. a mast is placed sufficiently nearby).

In the following, a range of these investigations are reviewed, with a focus on the documentation of damage or risks:

Balmori (2005), "*Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia)*"⁵⁴, p. 109 and 113 – 114:

"Monitoring of a white stork population in Valladolid (Spain) in the vicinity of Cellular Phone Base Stations was carried out, with the objective of detecting possible effects.

...

Birds are especially sensitive to the magnetic fields [48]. The white stork (Ciconia ciconia) build their nests on pinnacles and other very high places with high electromagnetic contamination (exposed to the microwaves). Also, they usually live inside the urban environment, where the electromagnetic contamination is higher, and remain in the nest a lot of the time, for this reason the decrease on the brood can be a good biological indicator to detect the effects of these radiations. The results indicate a difference in total productivity but not in partial productivity between the near nests and those far from the antennae. This indicate the existence of nests without chicks, or the death of young in their first stages in the nests near cellsites (40% of nest without young, compared to 3.3% in nests further 300 m).

⁵³ Published in 2009 in the scientific journal "Pathophysiology," vol. 16.

⁵⁴ Published in 2005 in the scientific journal "Electromagnetic Biology and Medicine," vol. 24, pp. 109 – 119.

...

The faithfulness of the white stork to nest sites can increase the effects of the microwaves.

...

Other studies find a decrease of fertility, increase of deaths after the birth in rats and dystrophic changes in their reproductive organs [16]. A recent study shows a statistically significant high mortality rate of chicken embryos subjected to the radiation from a cellphone, compared to the control group [43]. ..."

The white stork is admitted to "Annex I" of the EU directive on the conservation of wild birds, and thus belongs to the species for which "special conservation measures" must be made, cf. item 2.3.2. below.

Balmori and Hallberg (2007), "The Urban Decline of the House Sparrow (*Passer domesticus*): A Possible Link with Electromagnetic Radiation"⁵⁵, p. 141 (abstract):

"During recent decades, there has been a marked decline of the house sparrow (*Passer domesticus*) population in the United Kingdom and in several western European countries. The aims of this study were to determine whether the population is also declining in Spain and to evaluate the hypothesis that electromagnetic radiation (microwaves) from phone antennae is correlated with the decline in the sparrow population.

Between October 2002 and May 2006, point transect sampling was performed at 30 points during 40 visits to Valladolid, Spain. At each point, we carried out counts of sparrows and measured the mean electric field strength (radiofrequencies and microwaves: 1MHz–3GHz range). Significant declines ($P=0.0037$) were observed in the mean bird density over time, and significantly low bird density was observed in areas with high electric field strength. The logarithmic regression of the mean bird density vs. field strength groups (considering field strength in 0.1V/m increments) was $R = -0.87$ $P = 0.0001$.

The results of this article support the hypothesis that electromagnetic signals are associated with the observed decline in the sparrow population. We conclude that electromagnetic pollution may be responsible, either by itself or in combination with other factors, for the observed decline of the species in European cities during recent years. The apparently strong dependence between bird density and field strength according to this work could be used for a more controlled study to test the hypothesis" (Emphasis added.)

Elaborating on the manner in which it pertains to the currently employed limits, cf. item 2.1. below, it was ascertained (pp. 145 – 146) that :

"According to this calculation, no sparrows would be expected to be found in an area with field strength $>4V/m$ In monitored Area 14, Plaza de la Libertad, a picocell was installed at the beginning of January 2005 and removed at the end of March 2005. Between January and March 2005, the mean field strength was greater than $3V/m$, and the number of sparrows decreased drastically (generally, the number of sparrows increases towards a midwinter peak). In April 2005, after the picocell was removed, the sparrows became abundant again."

These electrical field strengths (V/m) are below the limits recommended by ICNIRP and are used by Denmark, cf. item 2.1. below.

Cucurachi et al.⁵⁶, "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)" (p. 122):

*"Balmori (2005) monitored the variation of a population of white storks (*Ciconia ciconia*) in the vicinity of a GSM base station i.e. 900–1800 MHz with 217 Hz modulation) in search of*

⁵⁵ Published in 2007 in the scientific journal "Electromagnetic Biology and Medicine," vol. 26, pp. 141 – 151.

⁵⁶ Published in 2013 in the scientific journal "Environment International," vol. 51, pp. 116 – 140.

possible effects from the exposure. Total productivity within 200 m was on average 46% less than that found at a distance greater than 300 m from the emitting station. An analogous significant difference was found in the breeding success: in 40% more of the cases no new-born chicks were found in the nest.

...

Amongst the more recent laboratory studies, evidence of an effect of RF-EMF on mortality and development of embryos was in all cases found at both high and low dosages. In all the five field studies found a significant effect of RF-EMF on breeding density, reproduction or species composition. Field observations give a closer representation of real-life exposure, thus RF-EMF, especially in the 900 MHz GSM band could be a certain factor influencing the ecology of birds."

Burlaka et al. (2013, p. 223):

"In conclusion, the exposure of developing quail embryos in ovo to extremely low intensity RF-EMR of GSM 900MHz during at least one hundred and fifty-eight hours discontinuously leads to the significantly increased rates of superoxide and nitrogen oxide generation in embryo cells. This was accompanied by a significantly increased level of lipid peroxidation, a depression of key antioxidant enzymes activity, and significantly, 2–3-fold, increased level of oxidative damage of DNA in embryo cells." (Emphasis added.)

Alfonso Balmori (2015), "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation"⁵⁷, p. 59:

Low-voltage electricity current-generated electromagnetic field can produce a significantly negative effect on the breeding success of birds (Ciconia ciconia) nesting directly on electricity lines (Vaitkuvienė and Dagys, 2014) and these same results have been found in nests exposed to radiofrequency radiation near phone masts (Balmori, 2005)."

Yakymenko et al. (2015, p. 194):

"We could ascertain the signaling effects of moderate levels of free radicals from our experiments in quail embryos irradiated with the commercial cell phone. Thus, we were able to show that the prolonged exposures of embryos in ovo led to robust repression of their development (Tsybulin et al., 2013), which was concomitant with significant overproduction of superoxide radical and NO radical, increased rates of lipid peroxidation and oxidative damage of DNA (Burlaka et al., 2013; Tsybulin et al., 2012)." (Emphasis added.)

Shende et al. (2015) "Electromagnetic Radiations: A Possible Impact on Population of House Sparrow (Passer Domesticus)"⁵⁸ (p. 45):

"By monthly monitoring in urban and rural area, it is found that the population of house sparrow is declining in the urban area, where cell phone towers are more as compared to the rural area in every season."

An area of special attention in the scientific literature is comprised of investigations into the effect of radiofrequent electromagnetic radiation on birds' biologically determined orientation abilities.

Birds are, like a range of other animals, cf. item 1.2.3.2. below, born with what can be described a form of a built-in, magnetically based compass, which implies that they will be able to find their way when migrating..

⁵⁷ Published in 2015 in the scientific journal "Science of the Total Environment," pp. 58 – 60.

⁵⁸ Published in 2015 in the scientific journal "Engineering International," vol. 3, no. 1, pp. 45 – 52.

Reference can be made to, e.g. Alfonso Balmori (2015), *"Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation,"*⁵⁹ (p. 58 – 59):

"Radio frequency fields in the MHz range disrupt birds' orientation interfering directly with the primary processes of magnetoreception and therefore disable the avian compass as long as they are present (Wiltschko et al., 2014). Ritz et al. (2004 & 2009) reported the sensitivity for orientation of European robins (Erithacus rubecula) to radiofrequency magnetic fields. The orientation of migratory birds is disrupted when very weak high-frequency fields (broadband field of 0.1–10 MHz of 85 nT or a 1.315 MHz field of 480 nT) are added to the static geomagnetic field of 46.000 nT (Thalau et al., 2006). It was convincingly demonstrated that robins are unable to use their magnetic compass in the presence of urban electromagnetic radiofrequency noise in the frequency range of 2 kHz–5 MHz (Engels et al., 2014). Therefore, electrosmog scrambles birds' magnetic sense and this finding could inform policies written to protect the habitats of endangered species. (Emphasis added.)"

Balmori (2005), *"Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia),"*⁶⁰ (p. 115):

"... The perception to the terrestrial magnetic field can be altered by the electromagnetic radiation from the antennae. The reports of carrier pigeons losing direction in the vicinity of cellsites are numerous, and more investigation is necessary. ..."

The EU-based research project EKLIPSE published a report by Malkemper et al. (2018) titled *"The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna). Current knowledge overview: a background document to the web conference,"* in which it is, e.g. stated (p. 15):

"...It is established that the magnetic compass of migratory birds can be disrupted by the weak RF background in larger cities (nT-intensities) but it is currently unclear which exact frequencies are most effective. ..."

Regarding this effect further reference can be made to Engels et al (2014), *"Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird"*⁶¹, p. 353 (abstract):

"...Here we show that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise. When European robins, Erithacus rubecula, were exposed to the background electromagnetic noise present in unscreened wooden huts at the University of Oldenburg campus, they could not orient using their magnetic compass. Their magnetic orientation capabilities reappeared in electrically grounded, aluminium-screened huts, which attenuated electromagnetic noise in the frequency range from 50kHz to 5MHz by approximately two orders of magnitude. When the grounding was removed or when broadband electromagnetic noise was deliberately generated inside the screened and grounded huts, the birds again lost their magnetic orientation capabilities. The disruptive effect of radiofrequency electromagnetic fields is not confined to a narrow frequency band and birds tested far from sources of electromagnetic noise required no screening to orient with their magnetic compass. These fully double-blinded tests document a reproducible effect of anthropogenic electromagnetic noise on the behaviour of an intact vertebrate. (Emphasis added)"

⁵⁹ Published in 2015 in the scientific journal "Science of the Total Environment," pp. 58 – 60.

⁶⁰ Published in 2005 in the scientific journal "Electromagnetic Biology and Medicine," vol. 24, pp. 109 – 119.

⁶¹ Published in 2014 in the scientific journal "Nature," no. 509, pp. 353 – 356.

1.2.3.1.1. Subject conclusion.

As is the case in relation to health damages and risk thereof for humans, it appears highly scientifically well documented that radiofrequent electromagnetic radiation, including that which remains within the (Danish) authorities' guidelines, is and can be damaging to the health of birds and (in extenso) their habitats.

Birds have a special trait that is their ability to orientate themselves partially based on an interaction with the Earth's naturally occurring magnetic field. Radiofrequent electromagnetic radiation's effect on birds' biologically determined abilities to orientate themselves can lead to the destruction of a species, including inside specially designated protected habitats. Particular to this issue, however, it must be highlighted that, for the time being, this does not seem to relate to 5G-frequencies, etc., though it could be the case. It appears that at the present time studies on this only show that birds' biologically determined sense of orientation is negatively affected by radiofrequent electromagnetic radiation.

1.2.3.2. Other animals.

Pertaining to insects, reference can be made to, e.g. Alfonso Balmori, *"Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation,"*⁶² (2015, p. 59):

"As with birds, radio frequency magnetic fields disrupt magnetoreception in insects. The geomagnetic field reception in American cockroach is sensitive to weak radio frequency field causing a disruptive effect (Vacha et al., 2009), so these authors suggest that electromagnetic smog will have to be taken more seriously in animal magnetoreception experiments. In an experimentally-generated electromagnetic field of about 1 V/m with a realistic (and even lower) power intensity similar to those surrounding communication masts, the results and observations suggest that GSM (Global System for Mobile communications) 900 MHz radiation might have a severe impact on the nerve cells of exposed ants, especially affecting the visual and olfactory memory, causing the loss of their ability to use visual cues and suggesting that electromagnetic radiation may have an impact on the orientation behaviour and navigation of animals that use magnetic fields to find their way (Cammaerts et al., 2012, 2014). Honeybees are sensitive to pulsed electromagnetic fields generated by mobile phones and observable changes in the bee behaviour could be one explanation for the loss of colonies (Favre, 2011). Magnetoreception system in Monarch butterfly orientation (Guerra et al., 2014) may be also suffering interference with anthropogenic radio frequency magnetic fields and this, together with other factors (Brower et al., 2012), may be a cause of their population decline." (Emphasis added.)

Correspondingly, in Cucurachi et al. (2012, p. 116)⁶³:

"Information was collected from 113 studies from original peer-reviewed publications or from relevant existing reviews... The majority of the studies were conducted in a laboratory setting on birds (embryos or eggs), small rodents and plants. In 65% of the studies, ecological effects of RF-EMF (50% of the animal studies and about 75% of the plant studies) were found both at high as well as at low dosages. ..."

Ibid. (p. 122 – 123):

"It has been demonstrated that insects can sense magnetic fields as a means for navigation and orientation (Abraçado et al., 2005; Kirschvink et al., 2001; Liedvogel and Mouritsen,

⁶² Published in 2015 in the scientific journal "Science of the Total Environment," pp. 58 – 60.

⁶³ Published in 2013 in the scientific journal "Environment International," vol. 51, pp. 116-140.

2010; Wajnberg et al., 2010; Winklhofer, 2010). Magneto-reception has been associated with the use of ferromagnetic iron oxide particles embedded in tissue or through pairs of molecules with unpaired electrons (known as radical pairs) that are associated with a light sensitive photoreceptor (Ritz et al., 2002; Knight, 2009; Vácha et al. 2009). The exposure to RF-EMF might disrupt this magneto-reception mechanism, which could in turn affect the survival of insects. The most commonly studied species are the honey bee (*A. mellifera*) and the fruit fly (*Drosophila melanogaster*)."

And (p. 129):

"The studies analysing the effects of RF-EMF on fruit flies found in all cases a significant effect. Results of one study show an increased reproductive success after exposure. The remaining studies, which were conducted by the same research institute in Greece, found in all cases a significant depression of growth and reproduction at both 900 and 1800 MHz. Two studies on the American cockroach and a species of ant analysed the effects of exposure to RF-EMF on the magneto-reception and orientation of the insects. The behaviour of target systems was disrupted by the exposure to RF-EMF."

Also (p. 136, conclusions):

"...The effects of RF-EMF on different biological groups were investigated. With reference to the groups under investigations in the selected studies (i.e. birds, honeybees, mammals, plants, *Drosophila* and others) there is ecologically relevant evidence that the RF-EMF caused an effect in about 50% of the animal studies and about 90% of the plant studies. ..."

Kumar et al. (2011), "Exposure to cell phone radiations produces biochemical changes in worker honey bees"⁶⁴ (abstract, results and discussion):

"The present study was carried out to find the effect of cell phone radiations on various biomolecules in the adult workers of *Apis mellifera* L. The results of the treated adults were analyzed and compared with the control. Radiation from the cell phone influences honey bees' behavior and physiology. There was reduced motor activity of the worker bees on the comb initially, followed by en masse migration and movement toward "talk mode" cell phone. The initial quiet period was characterized by rise in concentration of biomolecules including proteins, carbohydrates and lipids, perhaps due to stimulation of body mechanism to fight the stressful condition created by the radiations.

At later stages of exposure, there was a slight decline in the concentration of biomolecules probably because the body had adapted to the stimulus.

...

Very little work has been done on biochemical, metabolic and physiological influences of cell phone radiations pertaining to health risk in man.[8] Therefore, the present investigations on the influence of cell phone radiations on some biochemical and physiological aspects of honeybee biology were undertaken. That the behavior of honeybee is altered to some extent by high or low energy fields or electromagnetic radiations has been known for quite some time.[9]

During the present investigation, it was observed that there was an increase in concentration of total carbohydrates in the bees exposed to cell phone radiation for 10 min as compared to unexposed or control bees. Increasing the exposure time to 20 min resulted in further increase in the concentration, while an exposure of 40 min had a reverse effect and there was a decline in carbohydrate concentration, though it was still higher as compared to control. Hemolymph glycogen and glucose content also showed the same trend, i.e., there was increase in content up to 20 min exposure after which there was a slight decline in the concentration which

⁶⁴ Published in 2011 in the scientific journal "Toxicology International," vol. 18, no. 1, pp. 70 – 72.

remained more than the control. Sharma[10] had also reported increase in glycogen and glucose levels in the exposed pupa of *A. mellifera*.

Lipids are the major energy reserves of insects. Certain lipid classes are structure components of membranes while others are raw materials for a variety of hormones and pheromones. Estimation of total lipids and cholesterol during the present study showed that the trend was similar to that of carbohydrates. After an initial increase in concentration at the 10 and 20 min exposure period, a decline was observed in the concentration of total lipids and cholesterol at 40 min exposure.

It was interesting to note that during the present study as the exposure time increased, it appeared that the bees having assessed the source of the disturbance decided to move and a large scale movement of the workers toward the talk-mode (not toward the listening mobile) was observed. Also, the bees became slightly aggressive and started beating their wings in agitation. This mobility of the bees could be responsible for increase utilization of energy sources and consequent decrease in concentration of carbohydrates and lipids in the 40 min exposed sample." (Emphasis added.)

Margaritis et al. (2014), "*Drosophila oogenesis as a bio-marker responding to EMF sources*,"⁶⁵ (p. 165, abstract):

"A total of 280 different experiments were performed using newly emerged flies exposed for short time daily for 3–7 d to various EMF sources including: GSM 900/1800 MHz mobile phone, 1880–1900 MHz DECT wireless base, DECT wireless handset, mobile phone-DECT handset combination, 2.44 GHz wireless network (Wi-Fi), 2.44 GHz blue tooth, 92.8 MHz FM generator, 27.15 MHz baby monitor, 900 MHz CW RF generator and microwave oven's 2.44 GHz RF and magnetic field components.

...

All EMF sources used created statistically significant effects regarding fecundity and cell death-apoptosis induction, even at very low intensity levels (0.3 V/m blue tooth radiation), well below ICNIRP's guidelines, suggesting that *Drosophila oogenesis* system is suitable to be used as a biomarker for exploring potential EMF bioactivity. Also, there is no linear cumulative effect when increasing the duration of exposure or using one EMF source after the other (i.e. mobile phone and DECT handset) at the specific conditions used. ..."

The study was carried out on fruit flies, and on the strength of the findings it was recommended that this insect be used in future as a biological marker in examinations of the effects of radiofrequent electromagnetic radiation.

As is stated, cell death occurred even at very low intensities of radiation, as far down as 0,3 V/m from Blue Tooth-products.

The investigation shows that equipment which lies inside the ICNIRP recommended limits (e.g. 61 V/m for equipment within a frequency range of 2 – 300 GHz), cf. also item 2.1 below, must be expected to be highly damaging to insects.

Some insects are encompassed by the protection of the EU directive on the conservation of natural habitats and of wild fauna and flora, cf. item 2.3.3. below.

Add to this the fact that birds that live on insects will likewise have their habitats destroyed. For the contents of the EU directive on the conservation of wild birds cf. item 2.3.2. below.

⁶⁵ Published in 2014 in the scientific journal "Electromagnetic Biology and Medicine," vol 33, no. 3, pp. 165 – 189.

Cammaerts and Johansson (2014), "Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus,"⁶⁶ (p. 286, item 3):

"All radiating sources tested in this study on the ants demonstrated clear and statistically significant effects. It was already known that a mobile phone in standby mode affects living organisms (e.g. see Cammaerts et al., 2011; Favre, 2011; Panagopoulos et al., 2004; Sharma and Kumar, 2010). In this study, we showed that a common mobile phone has an effect while in standby mode and even in off-condition. Of course, when activated, the effect of a mobile phone is stronger. Without its battery, such a phone has no longer an effect. Our ants demonstrated that a modern smartphone and even more so a DECT phone do affect living organisms. Furthermore, the electromagnetic waves generated by a WiFi router impact our ants and such an effect increases during the course of the exposure time. Persons working in rooms provided with wireless equipment should note this result. A modern personal computer also generates electromagnetic waves. This is due to the PC WiFi function, which is automatically activated. Based on these results, we advice users to deactivate the WiFi function of their PC as long as they do not use it. This can also be deduced from the study related in <http://bigbrouser.blog.lemonde.fr/2011/12/01/microonde-le-wi-fi-tueur-de-spermatozoïdes/>." (Emphasis added.)

Especially regarding pollinators reference must be made to Lázaro et al. (2016), "Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators,"⁶⁷ (p. 322, conclusion):

"Electromagnetic radiation from telecommunication antennas affected the abundance and composition of wild pollinators in natural habitats....Pollinators and their host plants constitute pollination networks. Although the architecture of these mutualistic networks can increase the capacity of pollinator populations to persist under harsh conditions, once a tipping point in human-induced environmental change is reached, pollinator populations may collapse simultaneously (Lever et al. 2014). Therefore, these changes in the composition of pollinator communities associated with electromagnetic smog may have important ecological and economic impacts on the pollination service that could significantly affect the maintenance of wild plant diversity, crop production and human welfare."

This study thus shows a connection between radiation from mobile masts and the number of (flying) insects.

The composition of pollinators must be seen as an important ecological element for the production of crops, human welfare, and biodiversity in general.

Vilic et al. (2017), "Effects of short-term exposure to mobile phone radiofrequency (900 MHz) on the oxidative response and genotoxicity in honey bee larvae,"⁶⁸ (p. 430, abstract):

"Exposure of different animal species to radiofrequency electromagnetic fields (RF-EMF) could cause various biological effects such as oxidative stress, genotoxic effects and dysfunction of the immune system. However, there are a lack of results on oxidative stress response and genotoxicity in the honey bee (Apis mellifera) after exposure to RF-EMF. This study was performed to investigate the effects of exposure to RF-EMF on the activity of catalase, superoxide dismutase, glutathione S-transferase, lipid peroxidation level and DNA damage in

⁶⁶ Published in 2014 in the scientific journal "Electromagnetic Biology and Medicine," vol 33, no. 4, pp. 282 – 288.

⁶⁷ Published in 2016 in the scientific journal "Journal of Insect Conservation," vol. 20, no. 2, pp. 315 – 324.

⁶⁸ Published in 2017 in the scientific journal "Journal of Apicultural Research," vol. 56, no. 4, pp. 430 – 438.

honey bee larvae. Honey bee larvae were exposed to RF-EMF at 900 Mhz and field levels of 10, 23, 41 and 120 V m⁻¹ for 2 h. At a field level of 23 V m⁻¹ the effect of 80% AM 1 kHz sinusoidal and 217 Hz modulation was investigated as well. Catalase activity and the lipid peroxidation level decreased significantly in the honey bee larvae exposed to the unmodulated field at 10 V m⁻¹ compared to the control. Superoxide dismutase and glutathione S-transferase activity in the honey bee larvae exposed to unmodulated fields were not statistically different compared to the control. DNA damage increased significantly in honey bee larvae exposed to modulated (80% AM 1 kHz sinus) field at 23 V m⁻¹ compared to the control and all other exposure groups. These results suggest that RF-EMF effects in honey bee larvae appeared only after exposure to a certain EMF conditions. The increase of the field level did not cause a linear dose-response in any of the measured parameters. Modulated RF-EMF produced more negative effects than the corresponding unmodulated field. Although honey bees in nature would not be exposed to such high field levels as used in our experiments, our results show the need for further intensive research in all stages of honey bee development." (Emphasis added)

Ibid. (p. 437, conclusion):

"In conclusion, the results of our study showed that effects of RF-EMF at 900 MHz in honey bee larvae appeared only after exposure to the certain EMF conditions. RF-EMF modulated at 1 kHz showed an increase of DNA damage, while unmodulated RF-EMF produced alteration in catalase activity and lipid peroxidation at the lowest field level of 10 V m⁻¹. Evidently, the increase of the field level did not cause a linear dose-response relationship in any of the measured parameters. Although honey bees in nature would not be exposed to such high field levels as used in our experiments, our results show the need for further intensive research in all stages of honey bee development, as well as the intensive research on the possible existence of a "window" effect under natural conditions during the annual cycling of bees."

Thielens et al. (2018), "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz," (p. 9, conclusion, script version):

"The insects show a maximum in absorbed radio frequency power at wavelengths that are comparable to their body size. They show a general increase in absorbed radio-frequency power above 6 GHz (until the frequencies where the wavelengths are comparable to their body size), which indicates that if the used power densities do not decrease, but shift (partly) to higher frequencies, the absorption in the studied insects will increase as well. A shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3–370%. This could lead to changes in insect behaviour, physiology, and morphology over time due to an increase in body temperatures, from dielectric heating. The studied insects that are smaller than 1 cm show a peak in absorption at frequencies (above 6 GHz), which are currently not often used for telecommunication, but are planned to be used in the next generation of wireless telecommunication systems. At frequencies above the peak frequency (smaller wavelengths) the absorbed power decreases slightly."

As can be seen, this study also pertains to frequencies above 6 GHz, which will be employed with the use of 5G.

Studies regarding radiofrequent electromagnetic radiation's effect on bats⁶⁹ have been done in, e.g. Nicholls and Racey (2009), "The Aversive Effect of Electromagnetic Radiation on Foraging

⁶⁹ 15 species of bats are encompassed by the special conservation rules of the EU directive on the conservation of wild fauna and flora, cf. item 2.3.3. below.

Bats—A Possible Means of Discouraging Bats from Approaching Wind Turbines,” in which it is e.g. found that (p. 1, abstract):

“Large numbers of bats are killed by collisions with wind turbines and there is at present no accepted method of reducing or preventing this mortality. Following our demonstration that bat activity is reduced in the vicinity of large air traffic control and weather radars, we tested the hypothesis that an electromagnetic signal from a small portable radar can act as a deterrent to foraging bats. From June to September 2007 bat activity was compared at 20 foraging sites in northeast Scotland during experimental trials (radar switched on) and control trials (no radar signal). Starting 45 minutes after sunset, bat activity was recorded for a period of 30 minutes during each trial and the order of trials were alternated between nights. From July to September 2008 aerial insects at 16 of these sites were sampled using two miniature light-suction traps. At each site one of the traps was exposed to a radar signal and the other functioned as a control. Bat activity and foraging effort per unit time were significantly reduced during experimental trials when the radar antenna was fixed to produce a unidirectional signal therefore maximising exposure of foraging bats to the radar beam. However, although bat activity was significantly reduced during such trials, the radar had no significant effect on the abundance of insects captured by the traps.” (Emphasis added.)

Correspondingly, in “*Electromagnetic pollution from phone masts. Effects on wildlife,*”⁷⁰ (p. 4):

*“Electromagnetic radiation can exert an aversive behavioral response in bats. Bat activity is significantly reduced in habitats exposed to an electromagnetic field strength greater than 2 V/m [73]. During a study in a free-tailed bat colony (*Tadarida teniotis*) the number of bats decreased when several phone masts were placed 80m from the colony [74].”*

Regarding toads, reference can e.g. be made to Alfonso Balmori (2010), “*Mobile Phone Mast Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory,*”⁷¹ (p. 35):

“...Most prevailing hypotheses suggest that a field acts to directionally guide the growth and migration of some embryonic cells (Hotary and Robinson, 1992).

*Strong magnetic fields (1.74–16.7T) disrupt cell division of exposed frog eggs (*Xenopus laevis*) (Denegre et al., 1998). Valles (2002) proposed a model to explain their influence.*

*Several studies on effects of electromagnetic fields on amphibians have been conducted in laboratories. When amphibian eggs and embryos of *Ambystoma maculatum* and *Rana sylvatica* were exposed to high magnetic fields (6.3 10³ G), a brief treatment of early embryos produced several types of abnormalities, including microcephaly, retarded (abnormal) growth, edema, and scoliosis (Levengood, 1969).*

*Adult newts (*Notophthalmus viridescens*) exposed to a pulsed electromagnetic field (1 T and 0.15 V/m, approx.) for the first 30 days post forelimbs were amputated and produced more abnormalities in their skeletal patterns than the native limbs or the normal regenerates. Twelve percent exhibited unique abnormalities not observed in either the native or regenerate limb population. These forelimbs demonstrated one or more of the following gross defects: acheiria (lack of carpus and digits), aphalangia, or oligodactylia (loss of digits) as well as carpal bone and long bone (radius and ulna) abnormalities (Landesman and Douglas, 1990).*

*Exposed frog tadpoles (*Rana temporaria*) developed under electromagnetic field (50Hz, 260A/m) show an increase in mortality. Exposed tadpoles developed more slowly and less synchronously than control tadpoles and remained at the early stages for longer. Tadpoles developed allergies and EMF caused changes in their blood counts (Grefner et al., 1998). These results are consistent with the observations of this work.*

Deformities and disappearance of amphibians and other organisms is part of the global biodiversity crisis (Blaustein and Johnson, 2003). Some authors consider that the

⁷⁰ Published in 2009 in the scientific journal “Pathophysiology,”

⁷¹ Published in 2010 in the scientific journal “Electromagnetic Biology and Medicine,” vol. 29, pp. 31 – 35.

electromagnetic pollution is destroying nature (Warnke, 2007; Firstenberg, 1997). Balmori (2006) proposed that electromagnetic pollution (in the microwave and radiofrequency range) along with other environmental factors is a possible cause for decline and deformations of some wild amphibian populations exposed. The results of this experiment conducted in a real situation in the city of Valladolid (Spain) indicate that the tadpoles that live near such facilities, exposed to relatively low levels of environmental electromagnetic fields (1.8–3.5V/m) may suffer adverse effects (low coordination of movements, asynchronous growth, and high mortality), and this may be a cause (together with other environmental factors) of decline of amphibian populations.” (Emphasis added.)

The study has thus been carried out on what is perhaps the most common frog in Denmark, the “butsnudet frø” (*Rana temporaria*). The animal has been entered into Annex II of the EU directive on the conservation of natural habitats and of wild fauna and flora, and is thus protected by special rules of conservation, cf. item 2.3.3. below.

The investigation points out that aside from an indication of mutations and a long line of health damage to toads, the electromagnetic pollution from even relatively weak electromagnetic fields, which the environment is being exposed to, is a possible cause (along with other environmental factors) for the loss of reptilian populations.

On mice, reference can be made to, e.g. the following, in addition to the other articles mentioned in this legal opinion:

Magras and Xenos (1997), “RF Radiation–Induced Changes in the Prenatal Development of Mice” (p. 455):

“The possible effects of radiofrequency (RF) radiation on prenatal development has been investigated in mice. This study consisted of RF level measurements and in vivo experiments at several places around an “antenna park.” At these locations RF power densities between 168 nW/cm² and 1053 nW/cm² were measured. Twelve pairs of mice, divided in two groups, were placed in locations of different power densities and were repeatedly mated five times. One hundred eighteen newborns were collected. They were measured, weighed, and examined macro- and microscopically. A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility. The prenatal development of the newborns, however, evaluated by the crown-rump length, the body weight, and the number of the lumbar, sacral, and coccygeal vertebrae, was improved.” (Emphasis added.)

The mechanism for the observed sterility of mice is explained in this manner in Shahin et al. (2017), “Mobile phone (1800 MHz) radiation impairs female reproduction in mice, *Mus musculus*, through stress induced inhibition of ovarian and uterine activity,” (p. 41, abstract):

“Present study investigated the long-term effects of mobile phone (1800 MHz) radiation in stand-by, dialing and receiving modes on the female reproductive function (ovarian and uterine histo-architecture, and steroidogenesis) and stress responses (oxidative and nitrosative stress). We observed that mobile phone radiation induces significant elevation in ROS, NO, lipid peroxidation, total carbonyl content and serum corticosterone coupled with significant decrease in antioxidant enzymes in hypothalamus, ovary and uterus of mice. Compared to control group, exposed mice exhibited reduced number of developing and mature follicles as well as corpus lutea. Significantly decreased serum levels of pituitary gonadotrophins (LH, FSH), sex steroids (E2 and P4) and expression of SF-1, StAR, P-450scc, 3 β -HSD, 17 β -HSD, cytochrome P-450 aromatase, ER α and ER β were observed in all the exposed groups of mice, compared to control. These findings suggest that mobile phone radiation induces oxidative and nitrosative stress, which affects the reproductive performance of female mice.” (Emphasis added.)

Further, *ibid.* (p. 57):

“...Mobile phone radiation may result in ovarian and uterine dysfunction by increasing ROS and

RNS production and disturbing antioxidant status. Oxidative and nitrosative stress created at the hypothalamus and peripheral level (ovary and uterus) as a consequence of long-term mobile phone exposure may severely reduce both steroidogenesis and folliculogenesis in the ovary as well as the structural and functional status of the uterus. These results led us to conclude that chronic exposure to long-term mobile phone radiation may severely affect the ovarian and uterine activity of female mice and thus may lead to infertility. ..."

1.2.3.2.1. Subject conclusion.

It appears to be scientifically well documented that radiofrequent electromagnetic radiation, also within the limits set by (Danish) authorities, are and can be damaging to the health of insects.

Add to this that because of the special condition that insects' abilities to orientate are partially based on interaction with naturally occurring fields in, e.g. the flowers to be pollinated, radiofrequent electromagnetic radiation's effect on the biologically determined abilities to orientate can be devastating for the preservation of the species.

Further, the disappearance of insects from an area can have vital importance for insectivorous birds' abilities to survive as a species.

1.2.4. Further regarding habitats and plants.

Part of the research mentioned in item 1.2.3. above relates to habitats, as it pertains to studies on the effects of radiation on animals in the areas in which they nest, hunt, etc.

To this can be added scientific investigations on radiofrequent electromagnetic radiation on plants, including trees:

Magone (1996), *"The effect of electromagnetic radiation from the Skruna Radio Location Station on Spirodela polyrhiza (L.) Schleiden cultures,"*⁷² (p. 75, abstract):

"The effect of electromagnetic radiation from the Skruna Radio Location Station was studied on the vegetative growth and morphology of the duckweed Spirodela polyrhiza (L.) Schleiden plant in the next generation. The impact of plant development stage and length of the exposure period were examined. The effect of short-term (5-day) exposures of Spirodela cultures depended on the stage of development at the time of exposure. Generally, the vegetative reproduction rate was accelerated in the first 20 days after the end of exposure. Exposure of plants just beginning formation lowered the vegetative growth rate. Eighty-eight-hour exposure caused the appearance of some abnormal individuals after 30 days of growth. At 55 days, various morphological and developmental abnormalities appeared in 6–10 daughter plants from 10 exposed mother plants, compared with 0.1 plants per 10 in the control condition. Plants developed completely to daughter fronds under exposure from the electromagnetic field had a shorter life-span (67 days compared to 87 days in the control) and fewer subsequent daughters (total eight compared to 10 in the control group)." (Emphasis added.)

Katie Haggerty (2010), *"Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations,"*⁷³ (p.):

⁷² Published in 1996 in the scientific journal "Science of The Total Environment," vol. 180, no. 1, pp. 75 – 80.

⁷³ Published in 2010 in the scientific journal "International Journal of Forestry Research," article ID 836278.

"The results of this preliminary experiment indicate that the RF background may be adversely affecting leaf and shoot growth and inhibiting fall production of anthocyanins associated with leaf senescence in trembling aspen seedlings. These effects suggest that exposure to the RF background may be an underlying factor in the recent rapid decline of aspen populations. Further studies are underway to test this hypothesis in a more rigorous way."

Waldman et al. (2016), "Radiofrequency radiation injures trees around mobile phone base stations," (p. 554 – 555, abstract):

"...detailed long-term (2006–2015) field monitoring study was performed in the cities of Bamberg and Hallstadt (Germany). During monitoring, observations and photographic recordings of unusual or unexplainable tree damage were taken, alongside the measurement of electromagnetic radiation. In 2015 measurements of RF-EMF (Radiofrequency Electromagnetic Fields) were carried out. A polygon spanning both cities was chosen as the study site, where 144 measurements of the radiofrequency of electromagnetic fields were taken at a height of 1.5 m in streets and parks at different locations.

...

The measurements of all trees revealed significant differences between the damaged side facing a phone mast and the opposite side, as well as differences between the exposed side of damaged trees and all other groups of trees in both sides. Thus, we found that side differences in measured values of power flux density corresponded to side differences in damage. The 30 selected trees in low radiation areas (no visual contact to any phonemast and power flux density under 50 $\mu\text{W}/\text{m}^2$) showed no damage. 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." (Emphasis added.)

Malka Halgamuge (2017), "Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants"⁷⁴, p. 213 (abstract):

"Subject and methods: In this study, we performed an analysis of the data extracted from the 45 peer-reviewed scientific publications (1996–2016) describing 169 experimental observations to detect the physiological and morphological changes in plants due to the non-thermal RF-EMF effects from mobile phone radiation. Twenty-nine different species of plants were considered in this work. Results: Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, $p < 0.001$). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. 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) 3500⁷⁵ and 8000 MHz ($p = 0.0161$)." (Emphasis added.)

1.2.4.1. Subject conclusion.

⁷⁴ Published in 2017 in the scientific journal "Electromagnetic Biology AND Medicine," vol. 36, no. 2, pp. 213 – 235.

⁷⁵ 3.5 GHz is among the frequencies which, according to the Danish Energy Agency, will be reserved for the 5G system, cf. their action plan of February 2019 regarding 5G: https://ens.dk/sites/ens.dk/files/Tele/5g-handlingsplan_for_danmark.pdf, p. 10.

It seems scientifically well documented that radiofrequent electromagnetic radiation, also within the limits set by (Danish) authorities, is and can be damaging to plants.

In addition, the disappearance of plants from an area can have vital importance for the survivability of birds and insects as species.

1.3. Overall subject conclusion.

It is my belief that the scientific research materials analysed above document a clear and substantial causal link between the exposure of humans and animals to radiofrequent electromagnetic radiation on the one hand, and a range of damaging effects as well as possible damaging effects on both groups, including life threatening consequence, on the other hand.

Additionally, there is a well supported causal link regarding damage done to plants.

This is also true below the current limits, cf. also item 2.1. below.